ENVIRONMENT
HEALTH
SAFETY

ENVIRONMENTAL NOISE SPECIALIST ASSESSMENT:

Environmental Impact Assessment for the Proposed Development of the Klipkraal Wind Energy Facility 1, Northern Cape Province.

Report prepared for:	*Report prepared by:*
SiVEST (Pty) Ltd	**Dr Brett Williams (Safetech)**
La Lucia Ridge Office Estate	**64 Worraker Street**
4 Pencarrow Crescent	**Newton Park**
Umhlanga Rocks	**Gqeberha**
4320	**6057**
South Africa	**South Africa**

2 December 2022

Health and Welfare Sector Education and Training Authority HWSETA
HW592A1000508

Northern Office: PO Box 80171, Doornpoort, Pretoria, 0017 Tel: +27 (0)82 411 1571 Fax: +27 (0)86 6579864

Southern Office: PO Box 27607, Greenacres, Port Elizabeth 6057 Tel: +27 (0)41 3656846 / Fax: +27 (0)41 3652123 info@safetech.co.za / www.safetech.co.za
Safetrain cc T/A Safetech Reg. No 1992/034818/23
VAT No. 4180135461
Directors: B Williams, C Williams

Approved Inspection Authority (OH0049-CI-09)

Executive Summary

Safetech were appointed by SiVEST (Pty) Ltd to conduct an Environmental Noise Impact Assessment for the proposed construction of the Klipkraal Wind Energy Facility 1 (Klipkraal WEF 1) near Fraserburg in the Northern Cape Province.

A literature review and desktop modelling were conducted. Baseline monitoring was done of the residual noise levels at the site.

The results of the study indicate that the following conclusions can be drawn:

- There will be a short-term increase in noise in the vicinity of the site during the construction phase.
- The area surrounding the construction sites will be affected for short periods of time in all directions, should numerous construction equipment be used simultaneously.
- The day time SANS 10103:2008 noise limit of 45dB(A) will not be exceeded at any of the noise sensitive areas.
- The night-time outdoor guideline noise rating limit of 35dB(A) will not be exceeded at any of the noise sensitive areas, except at two noise sensitive areas (NSA 2 and NSA 8) when the windspeed is above 10m/s. There will most likely be wind noise masking at this windspeed that will mitigate the impact. On site monitoring at these two noise sensitive areas is recommended during the operational phase. Mitigation measures to be considered if the noise impact exceeds the 35dB(A) night noise rating limit, include running the turbines in low power mode at certain wind speeds at night. It is unlikely that the indoor limit will be exceeded as the residents' buildings will attenuate some sound.
- The cumulative impacts will not exceed the day time SANS 10103:2008 noise limit of 45dB(A).
- The cumulative impacts will exceed the night time SANS 10103:2008 noise limit of 35dB(A) at NSA 2 and NSA 8. There will most likely be wind noise masking at this windspeed that will mitigate the effect.
- The construction phase and operational phase will have a low noise impact on the noise sensitive receptors.

Due to the potential low noise impacts associated with the construction and operational phases of the proposed project, it is recommended the project receive Environmental Authorisation, from a noise impact perspective.

Dr Brett Williams

Table of Contents

List of Tables

List of Figures

List of Abbreviations

WTG	Wind Turbine Generator
dBA	The decibel is the unit used to measure sound pressure levels. The human ear does not perceive all sound pressures equally at all frequencies. The "A" weighted scale adjusts the measurement to approximate a human ear response.
DFFE	Department of Forestry, Fisheries, and the Environment
L_{Aeq}	The Equivalent continuous A-weighted sound pressure level.
L_{90}	Sound Pressure level exceeded for 90% of the measurement time
SANS	South African National Standards
WEF	Wind Energy Facility
MW	Megawatt
MP	Monitoring Point
NIA	Noise Impact Study
NEMA	National Environmental Management Act
NSA	Noise Sensitive Area

Glossary

Ambient Noise	Means the reading on an integrating impulse sound level meter taken at a measuring point, in the absence of any alleged disturbing noise, at the end of a total period of at least 10 minutes after such meter was put into operation. ***Authors Note:*** *Ambient noise includes the noise alleged to be causing a noise nuisance or disturbing noise.*
Ambient Noise (SANS 10103)	Totally encompassing sound in each situation at a given time, and usually composed of sound from many sources, both near and far *NOTE: Ambient noise includes the noise from the noise source under investigation.*
Annoyance	General negative reaction of the community or person to a condition creating displeasure or interference with specific activities.
dB(A)	Decibels weighted A scale - Value of the sound pressure level in decibels, determined using a frequency weighting network A (with reference to 20 µPa).
Disturbing Noise	"means a noise, excluding the unamplified human voice, which— (a) exceeds the rating level by 7 dBA; (b) exceeds the residual noise level where the residual noise level is higher than the rating level; (c) exceeds the residual noise level by 3 dBA where the residual noise level is lower than the rating level; or (d) in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103;

Equivalent Continuous Rating Level ($L_{Req,T}$)	The equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$) during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound and derived from the applicable equation: $L_{Req,T} = LAeq_{,T} + Ci + C_t + kn$ Where: $L_{aeq,T}$ is the equivalent A-weighted sound pressure level in decibels; Ci is the impulse correction; C_t is the correction for tonal character; Kn is the adjustment for day or night (0dB for day and +10dB for night measurements
Equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$)	Value of the A-weighted sound pressure level of a continuous steady sound that, within a specified time interval T_m, has the same mean-square sound pressure as a sound under consideration whose level varies with time and is given using the following equation: $LAeq,T = 10\log[\frac{1}{Tm}\int_{t1}^{t2}\frac{p_A^2(t)}{p_0^2}dt]$ Where: $L_{Aeq,T}$ is the equivalent continuous A-weighted sound pressure level, determined over a time interval T_m that starts at t_1 and ends at t_2 in decibels; $P_A(t)$ is the instantaneous A-weighted sound pressure of the sound signal, in pascals; P_o is the reference sound pressure (p_o=20µPa)
Low Frequency Noise	Means sound which contains sound energy at frequencies predominantly below 100 Hz.
Noise Nuisance	Any sound which impairs or may impair the convenience or peace of a reasonable person.
Noise Rating Level	The applicable outdoor equivalent continuous rating level indicated as per Table 2 of SANS 10103:2008.
Residual Noise (SANS 10103)	The all-encompassing sound in a given situation at a given time, measured as the reading on an integrated impulse sound level meter for a total period of at least 10 minutes, excluding noise alleged to be causing a noise nuisance or disturbing noise. Authors note: This would usually be called the "Ambient Noise", but in terms of the Regulations, "ambient noise" includes the noise under investigation.
SANS 10103:2008	The South African national standards code of practice for the measurement and rating of environmental noise with respect to annoyance and to speech communication.
SANS 10328:2008	The South African National Standards code of practice for environmental noise monitoring.
Sound Level	The equivalent continuous rating level as defined in SANS 10103, considering impulse, tone, and night-time corrections.
Sound Pressure Level (L_{pA})	Ten times the logarithm to the base 10 of the ratio of the square of the sound pressure, p_A, to the square of a reference value, p_0, expressed in decibels $L_{pA} = 10 \log \left(\frac{p_A}{p_o}\right)^2$ p_A is the root-mean-square sound pressure, using the frequency weighting network A (see SANS 61672-1 and SANS 656), in pascals p_o is the reference sound pressure (po = 20 µPa) NOTE 1 A-weighted sound pressure level is expressed in decibels. NOTE 2 The internationally accepted symbol for sound level, dBA, is used throughout this document
Sound Power (P)	Through a surface, a product of the sound pressure, *p*, and the component of the particle velocity, u_n, at a point on the surface in the direction normal to the surface, integrated over that surface Note 1 to entry: Sound power is expressed in watts. Note 2 to entry: The quantity relates to the rate at which airborne sound energy is radiated by a source.

Sound Power Level (L_w)	ten times the logarithm to the base 10 of the ratio of the *sound power*, P, of a source to a reference value, P_0, expressed in decibels $L_W = 10 \lg \frac{P}{P_0} \text{dB}$ where the reference value, P_0, is 1 pW If a specific frequency weighting as specified in IEC 61672-1 and/or specific frequency bands are applied, this is indicated by appropriate subscripts; e.g. L_{WA} denotes the A-weighted sound power level.

ENVIRONMENTAL NOISE SPECIALIST ASSESSMENT

1. Introduction

This report serves as the Noise Specialist Assessment that was prepared by Safetech as part of the Scoping and Environmental Impact Assessment (S&EIA) for the proposed development of the Klipkraal WEF 1 near Fraserburg in the Northern Cape Province.

1.1 Scope, Purpose and Objectives of this Specialist Report

A Noise Impact Assessment (NIA) for the Basic Assessment was conducted in accordance with SANS 10328:2008 (3rd Ed. and SANS 10103:2008 (6th Ed.). The scope of the project is described below:

- Determine the land use zoning of surrounding land and identify noise sensitive receptors that could be impacted upon by activities relating to the construction, operation and decommissioning of the wind farm.
- Determine the existing residual levels of noise within the study area.
- Determine the typical rating level for noise on surrounding land at identified noise sensitive receptors.
- Identify all noise sources, relating to the establishment and operation of the proposed wind farm that could potentially result in a noise impact at the identified noise sensitive receptors.
- Determine the sound power emission levels and nature of the sound emission from the identified noise sources.
- Calculate the expected noise level on surrounding land users and at the identified noise sensitive receptors from the combined sound power levels emanating from identified noise sources in accordance with procedures contained in SANS 10357 or similar.
- Calculate and assess the noise impact on surrounding land and at the identified noise sensitive receptors in terms of SANS 10103,10328; the Environment Conservation Act: National Noise Control Regulations (GNR 154 - 1992)
- Investigate alternative noise mitigation procedures, if required, in collaboration with the design engineers of the facility and estimate the impact of noise upon implementation of such procedures.
- Prepare and submit an environmental noise impact report in line with Appendix 6 of the EIA regulations, containing the procedures and findings of the investigation.
- Prepare and submit recommended noise mitigation procedures as part of a separate environmental noise management plan, if relevant.

1.2 Details of Specialist

This specialist assessment has been undertaken by Dr Brett Williams of Safetech, Brett Williams is registered with the Southern African Institute of Occupational Hygienists (SAIOH), with Registration Number 0220 as a Registered Occupational Hygienist. A curriculum vitae is included in Annexure A of this specialist assessment.

In addition, a signed specialist statement of independence is included in Annexure B of this specialist assessment.

1.3 Terms of Reference

The Term of Reference provided by the client for this noise study are as follows:

Conduct field surveys and compile specialist studies in adherence to:

- the gazetted Environmental Assessment Protocols of the NEMA EIA Regulations (2014, as amended), where applicable (**Protocol for the Specialist Assessment and Minimum Report Content Requirements for Noise Impacts** (GG 43110 / GNR 320, 20 March 2020)). This protocol replaces the requirements of Appendix 6 of the 2014 NEMA EIA Regulations (as amended); and
- any additional relevant legislation and guidelines that may be deemed necessary (e.g. noise standards and methodologies stipulated in SANS 10103:2008 and SANS 10328:2008 (or latest versions) for residential and non-residential areas as defined in these standards).
- Provide Site Sensitivity Verification Reports based on the requirements documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320.
- Following from the outcome of the site sensitivity verification, provide a Noise Impact Assessment (NIA) Report based on the requirements documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320.
- Determine, describe, and map the baseline environmental conditions and sensitivity of the study area. Specify setbacks or buffers and provide clear reasons for these recommendations. Also, map the extent of disturbance and transformation of the sites.
- Provide sensitivities in KMZ or similar GIS format.
- Provide review input on the preferred infrastructure layout i.e. wind turbines, construction platforms, construction camps, on-site substations, etc. following the sensitivity analysis and layout identification.
- Identify and assess the potential direct, indirect, and cumulative impacts of the proposed WEF development. Impact significance must be rated both <u>without</u> and <u>with</u> mitigation, and must cover the construction, operational and decommissioning phases of the projects. The Impact Assessment Methodology must follow that contained in Annexure D.

- Identify any additional protocols, legal and permit requirements that are relevant to these projects and the implications thereof.
- Provide recommendations with regards to potential monitoring programmes.
- Determine mitigation and/or management measures, which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts. Also, identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts. This must be included in the EMPr.
- Incorporate and address all review comments made by the Project Team (Atlantic Energy Partners and Project Applicant) (before public release) and following public review for submission to the Competent Authority for decision-making.
- Incorporate and address all issues and concerns raised by Stakeholders, Competent Authority, I&APs, and the public during the Public Participation Process (where relevant and applicable).

1.4 Approach and Methodology

The methodology used in the study consisted of three approaches to determine the noise impact from the proposed development and associated infrastructure:

- A desktop study to model the likely noise emissions from the site.
- Field measurements of the existing residual noise at different locations in the vicinity of the project during the day and night-time; and
- The identification of potential noise sensitive areas.

The desktop study was conducted using the available literature on noise impacts from wind turbines as well as numerical calculations of the possible noise emissions. A Danish modelling program, EMD WindPro Software Version 3.6 was used, which has been developed specifically for wind turbine noise. This program is used extensively worldwide and has been developed and validated in Denmark. The method described in SANS 10357:2004 version 2.1 (The calculation of sound propagation by the Concawe method) was used as a reference for further calculations where required.

WindPro uses the methods described in ISO 9613-2 (Acoustics – Attenuation of sound during propagation outdoors. Part 2 – General method of calculation). This method is very similar to SANS 10357:2004 and is used worldwide for modelling noise from various sources including wind turbine generators (Wind turbines). Where a tonal character is identified in the noise emitted from the turbines, a 5 dB(A) penalty is included in the modelling result.

The numerical results were then used to produce "noise maps" that visually indicate the extent of the noise emissions from the site. The noise emissions were modelled for various wind speeds from 3 m/s to 12 m/s. The direction of the wind was not taken into consideration as the wind could blow from any direction at the speeds that were modelled. The modelling is thus for worst-case scenarios and takes the topography around the turbine and location of the noise sensitive area (NSA) into account. The site elevation data was sourced from the NASA STRM database and imported into WindPro. A comparison was done using the digital elevation data and the contour heights from a topographical map. The comparison showed that the digital data and the map corresponded well. Furthermore, the digital data provided a better resolution.

For the field study, a long-term measurement was taken by placing a noise meter on a tripod and ensuring that it was placed at least 1.2 m from floor level and 3.5 m from any large flat reflecting surface. The measurement period lasted for approximately 36-hours and included one "day" period (06:00-22:00) and two "night" periods (22:00-06:00). The noise meter was calibrated before and after the survey. At no time was the difference more than one decibel (dBA) (Note: If the difference between measurements at the same point under the same conditions is more than 1 dBA, then this is an indication that the noise meter is not properly calibrated). The weighting used was on the A scale and the meter was placed on "fast", which is the preferred method as per SANS 10103:2008. The meter was fitted with a windscreen, which is supplied by the manufacturer. The windscreen is designed to reduce wind noise around the microphone and not bias the measurements. The short-term monitoring utilized the same method but over a 10-minute period for each measurement taken.

The test environment contained the following noise sources:

- Birds and insects;
- vegetation rustling; and
- Wind Noise.

The instrumentation that was used to conduct the study is as follows:

- **Rion NL-62 and UC-59L Integrating Sound Level Meter with built-in ⅓-Octave Filter and ½" Microphone with NC-74 Sound Calibrator:** Type 1, Rion NL-62, NH-26, UC-59L Integrating Sound Level Meter with built-in ⅓-Octave Filter and ½" Microphone. Serial no.: 00420125; 01697; 00840. Calibrated by: M and N Acoustic Services cc on 06-20 July 2021 (calibration due July 2022 as per SANS 10083:2013). Certificate number: 2021-AS-0751. Calibration certificate attached in Annexure. Total uncertainty of measurements: Integrating Sound Level Meter: Refer to calibration certificate. ½" Microphone: ± 0.3 dB. Built-in ⅓-Octave Filter: ± 0.3 dB.

- **Rion NC-74, NC-74-002 Sound Calibrator:** Serial no.: 34425540. Calibrated by: M and N Acoustic Services cc on 07 July 2021 (calibration due July 2022). Certificate number: 2019-AS-0749. Calibration certificate attached in Annexure. Total uncertainty of measurements: Sound Calibrator: ± 0.19 dB

1.5 Information Sources

The information used to conduct the study included:

- The project technical information was provided by the client e.g., turbine generator capacity and types, site layouts etc.
- Local, provincial, and national legislation and standards. The list of applicable legislation and standards is listed below.
- Satellite imagery and related GIS Data from Google Earth and QGIS.
- Residual Noise data collected onsite.

1.6 Assumptions, Knowledge Gaps and Limitations

The following assumptions and limitations are applicable to this study:

- The turbine positions were supplied by the applicant and are accepted as an accurate layout for the purposes of the environmental impact assessment.
- The worst-case scenario impacts were modelled. These scenarios consider factors such as wind blowing in any direction (not only the prevailing wind) and maximum turbine size as required for the site and the worst-case meteorological conditions.
- Due to final design parameters of the Wind Turbines being unconfirmed, the Goldwind 6.0MW model was chosen as the acoustic performance of this model is available to the author. Therefore, the developer will be able to choose any Wind Turbine Generator, provided the maximum Sound Power Level Rating does not exceed 111.6dB(A). If a model with a higher rating is chosen, this will require a reassessment of the noise impacts. The maximum Sound Power Level is based on the highest rated (from a noise perspective) Wind Turbines currently available on the market.
- No wind noise masking effect is considered.
- The noise levels at the identified noise sensitive areas could thus be lower if the wind noise masks the turbine noise emissions.
- For the cumulative impact assessment, it was assumed that all proposed projects would still undergo construction. Although this is unlikely, the assumption was made to assess the worst-case scenario.

- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 30 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are listed in Annexure F of this report.

2. Description of Project Aspects relevant to Environmental Noise

2.1 Background and General Description

The sources of sounds emitted from operating wind turbines can be divided into two categories, firstly mechanical sounds, from the interaction of turbine components, and secondly aerodynamic sounds, produced by the flow of air over the blades.

Mechanical Sounds

Mechanical sounds originate from the relative motion of mechanical components and the dynamic response among them. Sources of such sounds include:

- Gearbox;
- Generator;
- Yaw Drives;
- Cooling Fans; and
- Auxiliary Equipment (e.g., hydraulics).

Since the emitted sound is associated with the rotation of mechanical and electrical equipment, it tends to be tonal (of a common frequency), although it may have a broadband component. For example, pure tones can be emitted at the rotational frequencies of shafts and generators, and the meshing frequencies of the gears.

In addition, the hub, rotor, and tower may act as loudspeakers, transmitting the mechanical sound and radiating it. The transmission path of the sound can be air-borne or structure-borne. Air-borne means that the sound is directly propagated from the component surface or interior into the air. Structure-borne sound is transmitted along other structural components before it is radiated into the air.

Figure 1 below shows the type of transmission path, and the sound power levels for the individual components for a 2 MW wind turbine.

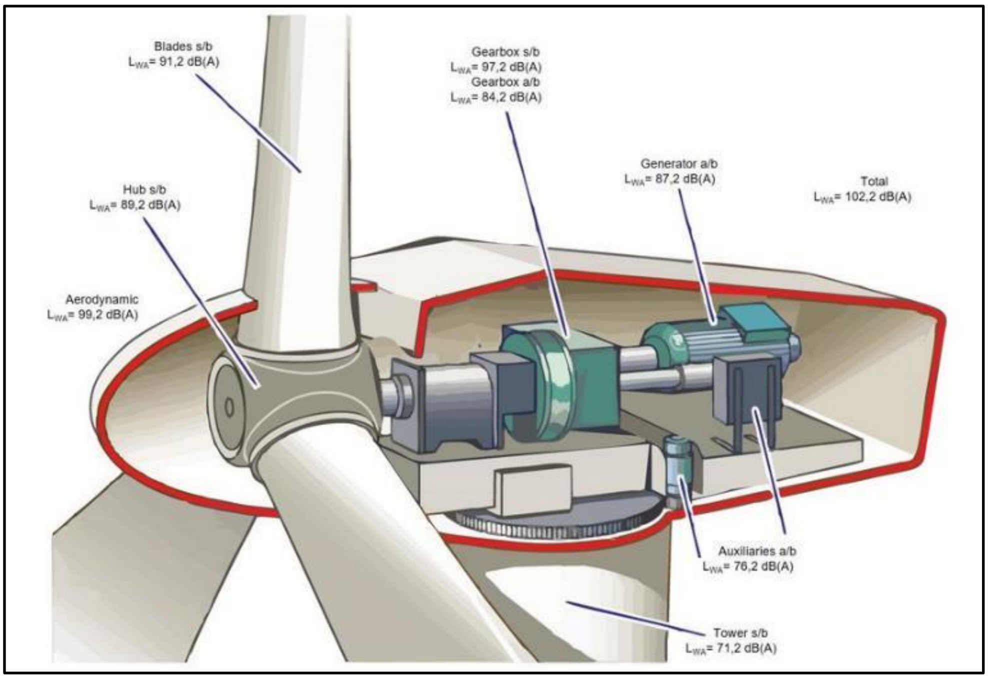


Figure 1: Typical Sound Power Levels of a 2 MW Turbine (Moraleda 2019)

Aerodynamic Sound

Aerodynamic broadband sound is typically the largest component of wind turbine acoustic emissions. It originates from the flow of air around the blades. A large number of complex flow phenomena occur, each of which might generate some sound (see Figure 2). Aerodynamic sound generally increases with rotor speed. The various aerodynamic sound generation mechanisms that must be considered are divided into three groups:

- Low Frequency Sound: Sound in the low frequency part of the sound spectrum is generated when the rotating blade encounters localized flow deficiencies due to the flow around a tower, wind speed changes, or wakes shed from other blades;
- Inflow Turbulence Sound: Depends on the amount of atmospheric turbulence. The atmospheric turbulence results in local force or local pressure fluctuations around the blade; and
- Aerofoil Self Noise: This group includes the sound generated by the air flow right along the surface of the aerofoil. This type of sound is typically of a broadband nature, but tonal components may occur due to blunt trailing edges, or flow over slits and holes.

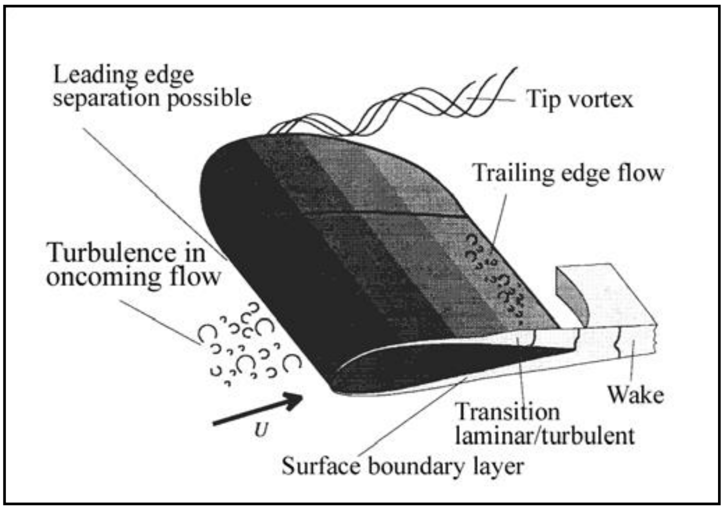


Figure 2: Sources of Aerodynamic Noise (Wagner 1996)

Modern air foil design takes all the above factors into account and are generally much quieter that the first generation of bade design.

Residual Sound & Wind Speed

The ability to hear a wind turbine depends on the residual sound level. When the background sounds and wind turbine sounds are of the same magnitude, the wind turbine sound may get lost in the background. Both the wind turbine sound power level and the residual sound pressure level will be functions of wind speed. Thus, whether the sound emitted from a wind turbine exceeds the residual sound level will depend on how each of these varies with wind speed.

The most likely sources of wind-generated sounds are interactions between wind and vegetation. Several factors affect the sound generated by wind flowing over vegetation. For example, the total magnitude of wind-generated sound depends more on the size of the windward surface of the vegetation than the foliage density or volume.

The sound level and frequency content of wind generated sound also depends on the type of vegetation. For example, sounds from deciduous trees tend to be slightly lower and more broadband than that from conifers, which generate more sounds at specific frequencies. The equivalent A-weighted broadband sound pressure generated by wind in foliage has been shown to be approximately proportional to the base 10 logarithm of wind speed.

Sound emitted from large modern wind turbines during constant speed operation tend to increase more slowly with increasing wind speed, than wind generated sound. As a result, wind turbine noise is more commonly a concern at lower wind speeds, and it is often difficult to measure sound from modern wind turbines above wind speeds of 8 m/s because the background wind-generated sound sometimes masks the wind turbine sound above 8 m/s.

It should be remembered that average sound level measurements might not indicate when a sound is detectable by a listener. Just as a dog's barking can be heard through other sounds, sounds with particular frequencies or an identifiable pattern may be heard through background sounds that is otherwise loud enough to mask those sounds. Sound emissions from wind turbines will also vary as the turbulence in the wind through the rotor changes. Turbulence in ground level winds will also affect a listener's ability to hear other sounds. Because fluctuations in ground level wind speeds will not exactly correlate with those at the hub height of the turbine, a listener might find moments when the wind turbine could be heard over the residual sound.

Low Frequency Noise and Infrasound

Infrasound was a significant characteristic of some wind turbine models that has been attributed to early designs in which turbine blades were downwind of the main tower. The effect was generated as the blades cut through the turbulence generated around the downwind side of the tower. Modern designs generally have the blades upwind of the tower. Wind conditions around the blades and improved blade design minimize the generation of the effect.

As depicted in Figure 3 below, low frequency pressure vibrations are typically categorized as low frequency sound when they can be heard near the bottom of human perception (10-200 Hz), and infrasound when they are below the common limit of human perception. Sound below 20 Hz is generally considered to be infrasound, even though there may be some human perception in that range. Because the ranges of low frequency sound and infrasound overlap it is important to understand how the terms are applied in a given context.

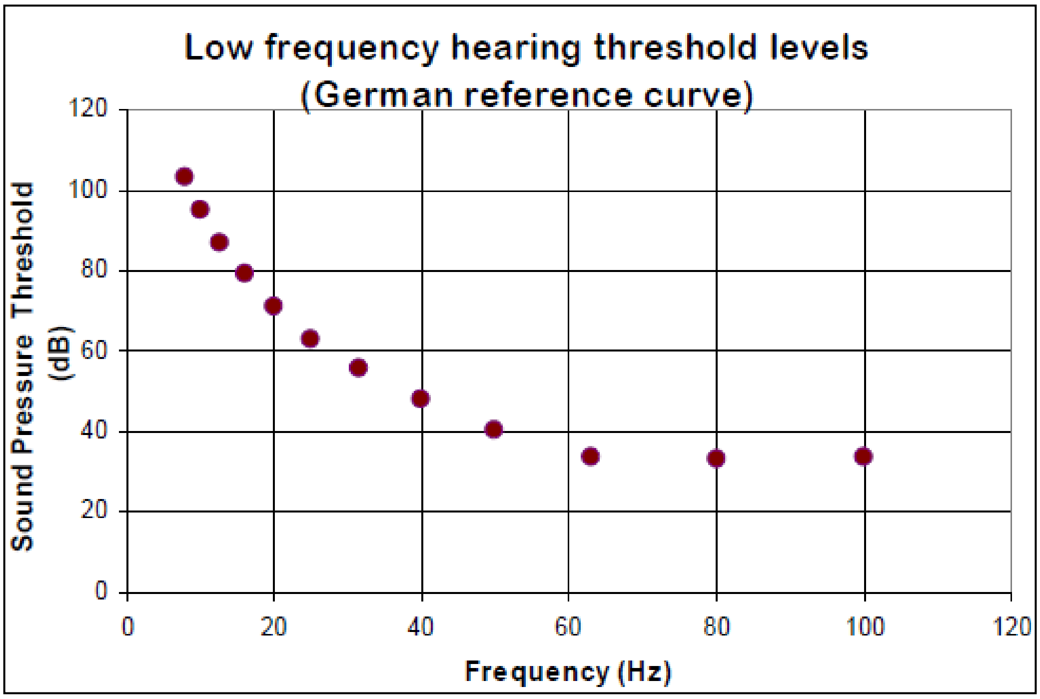


Figure 3: Low Frequency Hearing Threshold Levels

Infrasound is always present in the environment and stems from many sources including residual air turbulence from wind, ventilation units, waves on the seashore, distant explosions, traffic, aircraft, and other machinery. Infrasound propagates farther (i.e., with lower levels of dissipation) than higher frequencies. To place infrasound in perspective, when a child is swinging high on a swing, the pressure changes on their ears, from top to bottom of the swing, is nearly 120 dB(A) at a frequency of around 1 Hz.

Some characteristics of the human perception of infrasound and low frequency sound are:

- Low frequency sound and infrasound (2-100 Hz) are perceived as a mixture of auditory and tactile sensations.
- Lower frequencies must be of a higher magnitude (dB) to be perceived, e.g., the threshold of hearing at 10 Hz is around 100 dB (see Figure 3 above);
- Tonality cannot be perceived below around 18 Hz; and
- Infrasound may not appear to be coming from a specific location, because of its long wavelengths.

The primary human response to perceived infrasound is annoyance, with resulting secondary effects. Annoyance levels typically depend on other characteristics of the infrasound, including intensity, variations with time, such as impulses, loudest sound, periodicity, etc. Infrasound has three annoyance mechanisms:

- A feeling of static pressure;
- Periodic masking effects in medium and higher frequencies; and
- Rattling of doors, windows, etc. from strong low frequency components.

Human effects vary by the intensity of the perceived infrasound, which can be grouped into these approximate ranges:

- 90 dB and below: No evidence of adverse effects';
- 115 dB: Fatigue, apathy, abdominal symptoms, hypertension in some humans;
- 120 dB: Approximate threshold of pain at 10 Hz; and
- 120 – 130 dB and above: Exposure for 24 hours causes physiological damage.

The typical range of sound power level for wind turbine generators is in the range of 100 to 111.6 dB(A) – a much lower sound power level (10 dB or more) than the majority of construction machinery such as bulldozers. For infrasound to be audible even to a person with the most sensitive hearing at a distance of 300 m would require a sound power level of at least 140 dB at 10 Hz and even higher emission levels than this at lower frequencies and at greater distances. There is no information available to indicate that wind turbine generators emit infrasound anywhere near this intensity.

2.2 Identification of Noise Sources

The facility will be comprised of 50 individual Wind Turbine Generators (WTGs) making up a total generation capacity of up to 300 MW. The final design specifications have not yet been confirmed and the developers are considering several options, of which one of the preferred is presented in Table 1 below.

Table 1: Turbine Models under consideration

Manufacturer	Model	Hub height (m)	Rotor Diameter (m)	Blade Length (m)
GoldWind	N/A	Up to 200	Up to 200 m	Up to 100 m

The final WTG model has not yet been confirmed by the developer. The known parameters are a hub height of up to 200 m and blade length of up to 100 m. Further details of the WTG that was used are described in Table 2 below.

The model of Turbine chosen will represent a likely worst-case scenario of 111.6dB(A) maximum sound power level. The modelled hub height is 200 m. If a higher or lower final hub height is chosen, the noise impacts could be reduced or increase depending on the sound power of the turbine. Furthermore, if the final turbine that is chosen has a maximum sound power level that is similar or lower than the turbine modelled in this report, it can be assumed that the noise impacts will be similar or lower, irrespective of the turbine manufacturer.

Table 2: Modelled Turbine Specifications

Manufacturer	Goldwind
Type / Version	GW165-6.0
Rated Power Output	6MW
Rotor Diameter	Up to 200 m
Tower	Tubular
Grid Connection	50/60 Hz
Maximum Sound Power Level	111.6 dB(A)
Hub Height	200 m
Turbine Power Mode	Mode 0

Sound Power Level dB(A) reference to 1pW inferred from WindPro 3.6 Catalogue

**The specifications of this turbine model were used as this is the preferred model of the applicant. This does not bind the applicant to this specific model, and any turbine model with similar turbine specifications will be acceptable. An equal or lower maximum sound power level would be acceptable for the site without the need for re-modelling, provided the turbine positions do not change substantially (i.e more than 50 m).*

Figure 4 below shows the layout of the 50 WTGs in addition to the site boundary. The turbine positions are based on geospatial data supplied by the client.

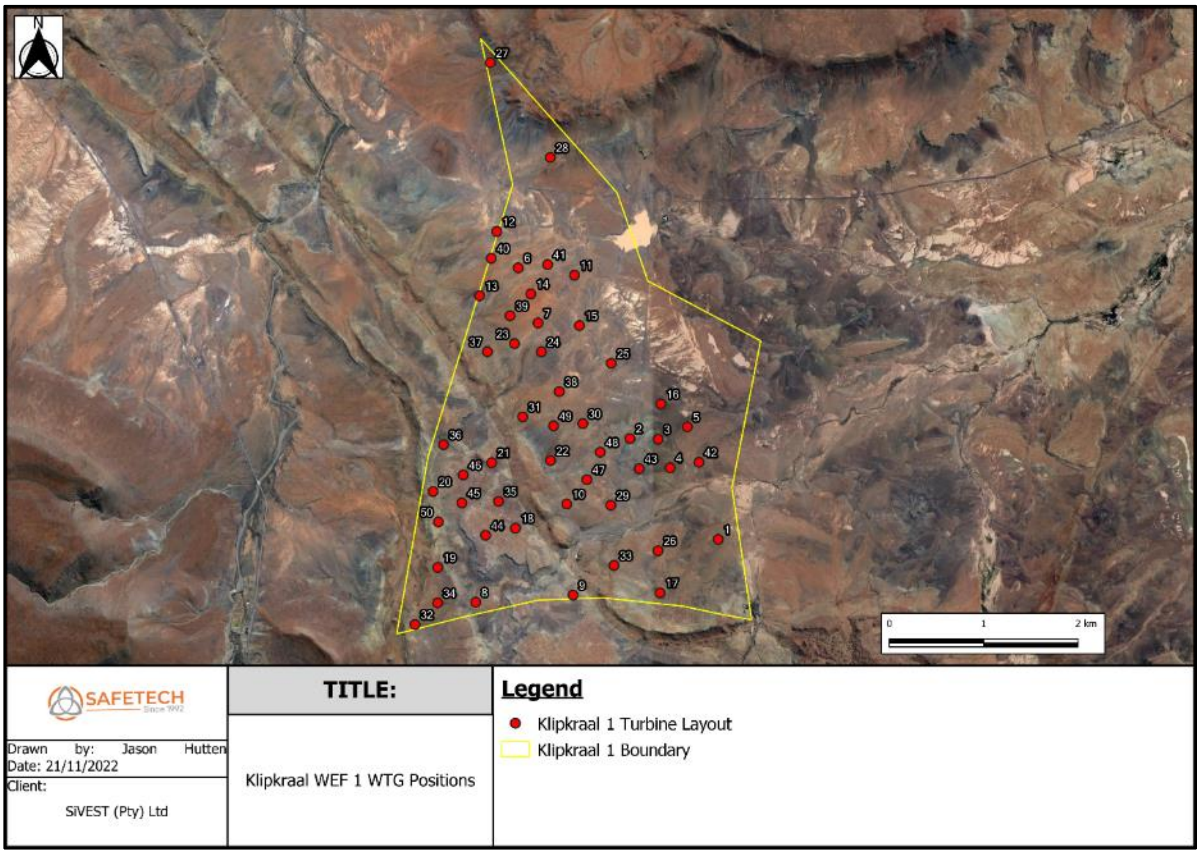


Figure 4: Klipkraal WEF 1 Turbine Layout.

The coordinates of the 50 WTGs are given in Table 3 below.

Table 3: WTG Coordinates

WTG Name	Latitude	Longitude
1	32 ° 5' 23.127" S	21 ° 46' 49.444" E
2	32 ° 4' 48.555" S	21 ° 46' 13.737" E
3	32 ° 4' 48.792" S	21 ° 46' 25.171" E
4	32 ° 4' 58.550" S	21 ° 46' 29.951" E
5	32 ° 4' 44.546" S	21 ° 46' 36.932" E
6	32 ° 3' 50.044" S	21 ° 45' 28.575" E
7	32 ° 4' 08.951" S	21 ° 45' 36.614" E
8	32 ° 5' 44.631" S	21 ° 45' 11.422" E
9	32 ° 5' 42.204" S	21 ° 45' 50.741" E
10	32 ° 5' 10.971" S	21 ° 45' 48.144" E
11	32 ° 3' 52.547" S	21 ° 45' 51.294" E
12	32 ° 3' 37.570" S	21 ° 45' 19.906" E
13	32 ° 3' 59.602" S	21 ° 45' 12.962" E
14	32 ° 3' 58.962" S	21 ° 45' 33.661" E
15	32 ° 4' 09.799" S	21 ° 45' 53.302" E
16	32 ° 4' 36.680" S	21 ° 46' 26.237" E
17	32 ° 5' 41.452" S	21 ° 46' 25.887" E

WTG Name	Latitude	Longitude
18	32 ° 5' 19.297" S	21 ° 45' 27.478" E
19	32 ° 5' 32.743" S	21 ° 44' 56.050" E
20	32 ° 5' 06.701" S	21 ° 44' 54.190" E
21	32 ° 4' 56.820" S	21 ° 45' 17.863" E
22	32 ° 4' 56.103" S	21 ° 45' 41.645" E
23	32 ° 4' 16.006" S	21 ° 45' 27.073" E
24	32 ° 4' 18.820" S	21 ° 45' 37.982" E
25	32 ° 4' 22.788" S	21 ° 46' 06.167" E
26	32 ° 5' 27.012" S	21 ° 46' 25.094" E
27	32 ° 2' 39.699" S	21 ° 45' 17.249" E
28	32 ° 3' 12.207" S	21 ° 45' 41.520" E
29	32 ° 5' 11.401" S	21 ° 46' 05.998" E
30	32 ° 4' 43.428" S	21 ° 45' 54.683" E
31	32 ° 4' 41.091" S	21 ° 45' 30.404" E
32	32 ° 5' 52.281" S	21 ° 44' 46.866" E
33	32 ° 5' 32.046" S	21 ° 46' 07.287" E
34	32 ° 5' 44.876" S	21 ° 44' 56.014" E
35	32 ° 5' 10.091" S	21 ° 45' 20.651" E
36	32 ° 4' 50.623" S	21 ° 44' 58.393" E
37	32 ° 4' 18.772" S	21 ° 45' 16.135" E
38	32 ° 4' 32.455" S	21 ° 45' 45.174" E
39	32 ° 4' 06.433" S	21 ° 45' 25.300" E
40	32 ° 3' 46.753" S	21 ° 45' 17.689" E
41	32 ° 3' 48.908" S	21 ° 45' 40.466" E
42	32 ° 4' 56.681" S	21 ° 46' 41.617" E
43	32 ° 4' 58.869" S	21 ° 46' 17.479" E
44	32 ° 5' 21.707" S	21 ° 45' 15.409" E
45	32 ° 5' 10.629" S	21 ° 45' 05.795" E
46	32 ° 5' 01.019" S	21 ° 45' 06.360" E
47	32 ° 5' 02.631" S	21 ° 45' 56.328" E
48	32 ° 4' 53.216" S	21 ° 46' 01.744" E
49	32 ° 4' 44.182" S	21 ° 45' 42.889" E
50	32 ° 5' 17.119" S	21 ° 44' 56.333" E

3. Baseline Environmental Description

3.1 General Description

Klipkraal Wind Facility 1 (Pty) Ltd proposes the development of a Wind Energy Facility approximately 35km to the southeast of Fraserburg in the Northern Cape Province.

The project will comprise of up to 50 turbines producing a maximum export capacity of up to approximately 300MW.

This development (Klipkraal WEF 1) will include auxiliary infrastructure such as substations and access roads. However, for the purpose of this Noise Study, these auxiliary components have not been assessed as their impact will be negligible.

Two additional WEF's are being considered on the properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Klipkraal Wind Energy Facility 2 (Klipkraal WEF 2) and Klipkraal Wind Energy Facility 3 (Klipkraal WEF 3). These projects fall under separate Environmental Applications and are only assessed for cumulative impacts in this report.

The construction noise impacts from the access road traversing the project were assessed in conjunction with the noise impacts from the Wind Turbine Generators. All other infrastructure was not included as part of the noise study as these features are not expected to impact sensitive receptors in the area.

The current land use of the proposed properties is an agricultural area with sheep and goat farming conducted in a very arid environment – this is the only agricultural land use on the site and surrounds which is restricted by the arid nature of the local climate. Due to the limited stock carrying capacity, the farms are large in size. The area has a very low density of rural settlement, with relatively few isolated farmsteads. Man-made modifications associated with farming are related to those typical of the low intensity sheep farming. This includes wind pumps with stock watering points. These features are small in scale in the landscape and do not detract from the sense of place.

The land use of the receiving environment in relation to the Klipkraal WEF 1 site can be classified as rural (agricultural, focusing primarily on livestock). Furthermore, the topography of the area is characterized by relatively flat terrain with hills, and valleys. The area is sparsely populated with homesteads and kraals. During the analysis of the satellite imagery, it was difficult to confirm the classification of each structure identified. To eliminate uncertainty, it was assumed that all structures are occupied to simulate a worst-case scenario (despite the likelihood that some structures are abandoned and unoccupied).

3.2 Field Study

The field study validated the classification of the study area as a rural district. Table 4 below shows the SANS 10103:2008 guidelines for day and night noise limits of a rural district. These guidelines are discussed in further detail in Section 7 of this report. National and provincial standards classify noise levels exceeding 7dB(A) above the residual noise levels as a disturbing noise.

Table 4: Noise limits for rural districts

Type of District	Equivalent Continuous Rating Level, LReq.T for Noise					
	Outdoors (dB(A))			Indoors, with open windows (dB(A))		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
Rural Districts	45	45	35	35	35	25

The field study was conducted from the 18th of September 2021 to the 24th of September 2021 in accordance with SANS 10103:2008. The guidelines to determine the residual noise levels of the area are described in the methodology below:

A long-term measurement was taken by placing a noise meter on a tripod and ensuring that it was placed at least 1.2 m from floor level and 3.5 m from any large flat reflecting surface. The 36-hour measurement time encompassed one "day" period (06:00-22:00) and two "night" periods (22:00-06:00). The noise meter was calibrated before and after the survey. At no time was the difference more than one decibel (dB) (Note: If the difference between measurements at the same point under the same conditions is more than 1 dB, then this is an indication that the noise meter is not properly calibrated). The weighting used was on the A scale and the meter was placed on "fast", which is the preferred method as per SANS 10103:2008, the measurement and rating of environmental noise. The meter was fitted with a windscreen, which is supplied by the manufacturer. The windscreen is designed to reduce wind noise around the microphone and not bias the measurements. The short-term monitoring utilized the same method but over a 10-minute period for each measurement taken.

The results of the baseline residual noise monitoring for the long-term measurement are shown in Figure 5 and Figure 6 below. Monitoring was conducted at three locations surrounding the proposed development. However, due to the changing of the layout, only Monitoring Point 1 and Monitoring Point 2 were chosen based on the proximity to the proposed project location. The noise sources during the time of the monitoring were typical of the rural Karoo landscape. Noise sources included birds chirping, wind noise and leaves rustling. Weather conditions during the daytime hours were sunny.

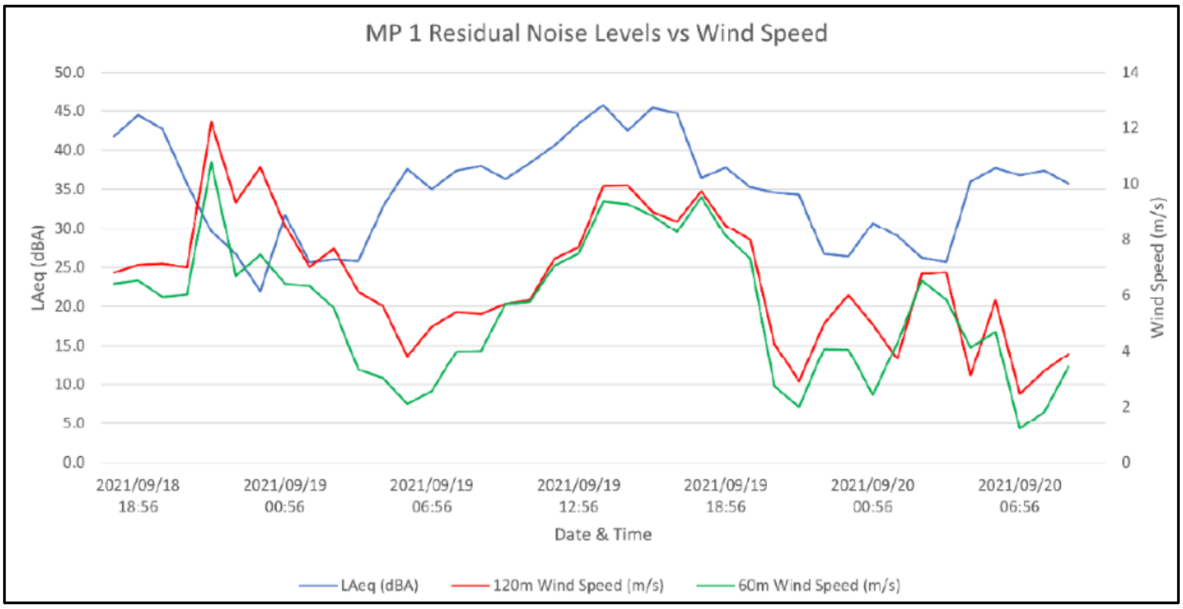


Figure 5: Long Term Ambient Noise Levels vs Weather Conditions at MP 1

The L_{Aeq} value at Monitoring Point 1 was as follows:

- Day time (06:00-22:00): **40.8dB(A)**
- Night time (22:00-06:00): **30.3 dB(A)**

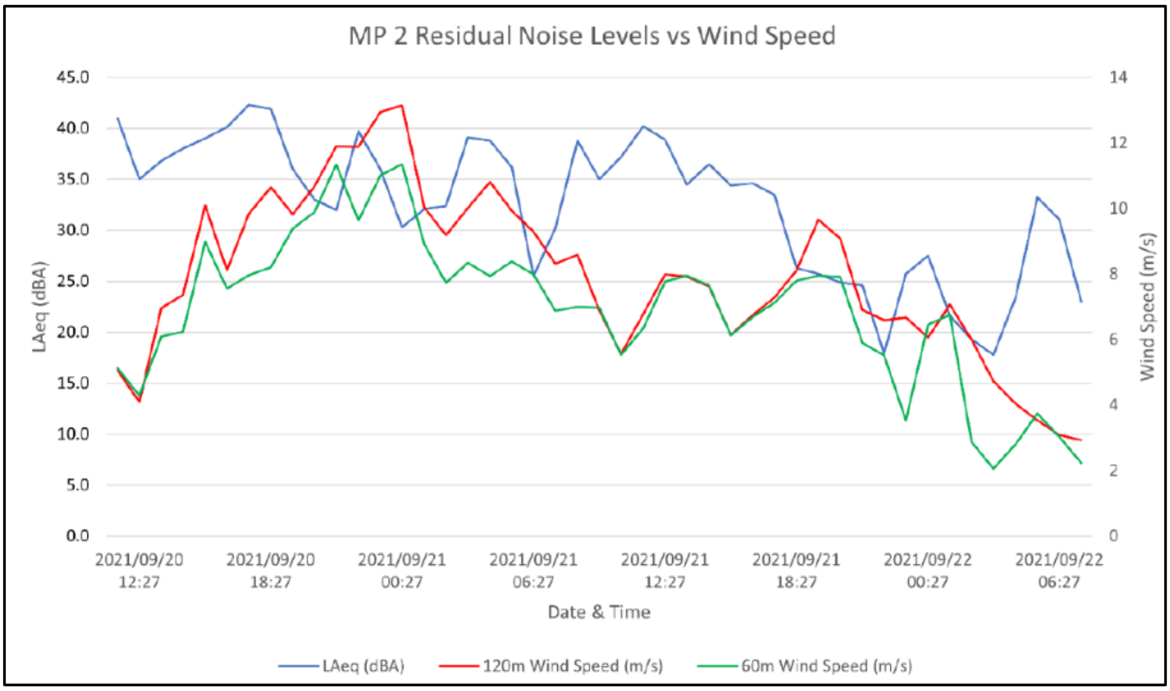


Figure 6: Long Term Ambient Noise Levels vs Weather Conditions at MP 2

The L_{Aeq} value at Monitoring Point 2 was as follows:

- Day time (06:00-22:00): **37.0dB(A)**
- Night time (22:00-06:00): **34.0 dB(A).**

Two weather stations are located within the study area. Weather Station 2 wind speeds, recorded at 60m and 120m above ground level, were used as this station was closer to the monitoring points. The Coordinates of Weather Station 2 are: 32° 5' 29.40" S; 21° 47' 49.70" E.

The location of the monitoring equipment can be seen in Figure 7 below. These points were taken at the closest NSAs, namely NSA 2 and NSA 8.

4. Identification of Environmental Sensitivities

4.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

Human Sensitive Receptors

The initial identification of potential noise sensitive areas was conducted through a visual scan of satellite imagery of the area. A total of 23 Noise Sensitive Areas (NSA's) were identified. These NSAs are a combination of farmer's houses, staff houses, remote homesteads and possibly "Shepherd's Huts".

Figure 7 below shows the location of the NSAs in relation to the development boundary. The location of the long-term monitoring point is also depicted.

Due to the presence of these NSAs, it can be confirmed that the sensitivity rating "Very High" is applicable.

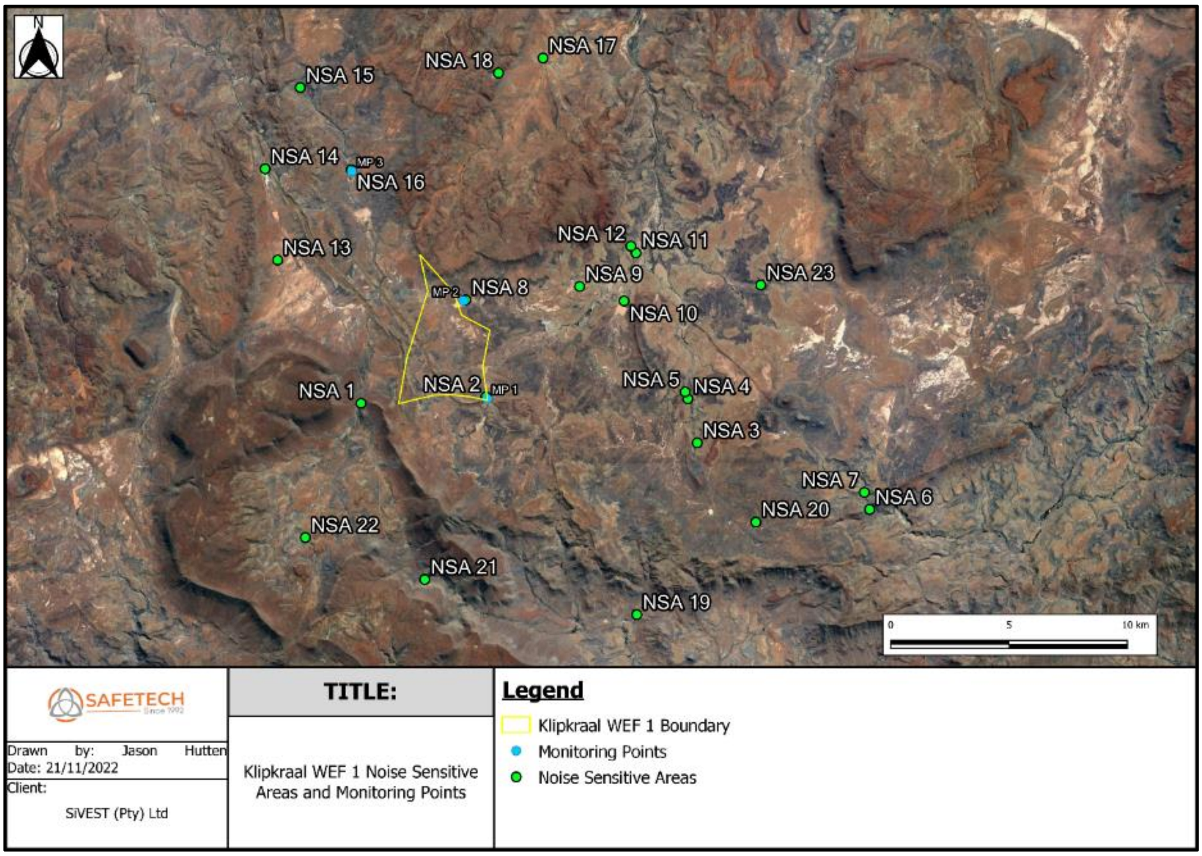


Figure 7: Locations of Noise Sensitive Areas and Monitoring Points

Figure 7 above shows the locations of the 23 NSAs and the Monitoring Points. Monitoring Point 3 (MP 3) is shown for informational purposes only as it is not applicable to this study due to its distance from the location of the proposed project. The coordinates of the identified NSAs, in addition to the distance of the nearest WTG is described in Table 5 below.

Table 5: Coordinates of Noise Sensitive Areas

Name	Latitude	Longitude	Nearest WTG	Distance to Nearest WTG (m)
NSA 1	32°05'54,99" S	21°43'38,68" E	32	2 110
NSA 2	32°05'46,00" S	21°47'00,18" E	1	898
NSA 3	32°06'48,99" S	21°52'41,18" E	1	11 318
NSA 4	32°05'48,87" S	21°52'26,01" E	1	10 449
NSA 5	32°05'39,37" S	21°52'21,75" E	1	10 292
NSA 6	32°08'20,06" S	21°57'19,43" E	1	20 523
NSA 7	32°07'56,72" S	21°57'10,97" E	1	20 020
NSA 8	32°03'33,62" S	21°46'27,74" E	11	1 321
NSA 9	32°03'15,20" S	21°49'31,49" E	5	6 305
NSA 10	32°03'35,13" S	21°50'43,12" E	5	8 022
NSA 11	32°02'29,34" S	21°51'02,26" E	5	9 573
NSA 12	32°02'20,12" S	21°50'54,23" E	5	9 542

Name	Latitude	Longitude	Nearest WTG	Distance to Nearest WTG (m)
NSA 13	32°02'39,11" S	21°41'23,98" E	27	7 213
NSA 14	32°00'34,29" S	21°41'03,90" E	27	9 071
NSA 15	31°58'43,05" S	21°42'00,55" E	27	10 557
NSA 16	32°00'35,33" S	21°43'22,84" E	27	5 752
NSA 17	31°58'02,73" S	21°48'32,32" E	27	11 763
NSA 18	31°58'23,24" S	21°47'20,55" E	27	10 099
NSA 19	32°10'43,76" S	21°51'03,72" E	17	13 988
NSA 20	32°08'37,40" S	21°54'15,88" E	1	15 520
NSA 21	32°09'55,66" S	21°45'21,43" E	32	8 951
NSA 22	32°08'58,41" S	21°42'08,79" E	32	8 371
NSA 23	32°03'13,29" S	21°54'23,65" E	42	14 776

Natural Environment Receptors

The vegetation surrounding the development site is characterised by typical karoo vegetation. The fauna includes bats, birds, commercial livestock, smaller mammals, reptiles, and buck.

5. Issues, Risks, and Impacts

The following section discusses the potential impacts, from a noise perspective, on the human receptors previously identified. These impacts have been classified according to the various stages of the project, namely the construction phase, operational phase, decommissioning phase.

5.1 Predicted noise levels for the Construction Phase

The construction noise at the various sites will have a local impact. Safetech has conducted noise tests at various sites in South Africa and have recorded the noise emissions of various pieces of construction equipment. The results are presented in Table 6 below.

Table 6: Typical Construction Noise

Type of Equipment	$L_{Req.T}$ dB(A)
CAT 320D Excavator measured at approximately 50 m.	67.9
Mobile crane measured at approximately 70 m	69.6
Drilling rig measured at approximately 70 m	72.6

The impact of the construction noise that can be expected at the proposed site can be extrapolated from the Tables above and below. As an example, if several pieces of equipment are used simultaneously, the noise levels can be added logarithmically and then calculated at various distances from the site to determine the distance at which the residual level will be reached (refer to Tables 7 – 9).

Table 7: Combining Different Construction Noise Sources – High Impacts (Worst Case)

Description	Typical Sound Power Level (dB)
Overhead and mobile cranes	109
Front end loaders	100
Excavators	108
Bulldozer	111
Piling machine (mobile)	115
Total*	117

*The total is a logarithmic total and not a sum of the values (at approximately 3 m).

Table 8: Combining Different Construction Noise Sources – Low Impacts (at approximately 3 m)

Description	Typical Sound Power Level (dBA)
Front end loaders	100
Excavators	108
Truck	95
Total	111

*The total is a logarithmic total and not a sum of the values (at approximately 3 m).

The information in Tables 7 to 9 can then be used to calculate the attenuation by distance. Noise will also be attenuated by topography and atmospheric conditions such as temperature, humidity, wind speed and direction etc. but this is ignored for this purpose. Therefore, the distance calculated below would be representative of maximum distances to reach residual noise levels.

An illustration of attenuation by distance from a noise of 117 dB measured from the source is presented in Table 9 below.

Table 9: Attenuation by Distance

Distance from noise source (m)	Sound Pressure Level dB(A)
10	89
20	83
40	77
80	71
160	65
320	59
640	53
1280	47

What can be inferred from Table 9 above is that if the residual noise level is at 45 dB(A), the construction noise will be similar to the residual noise level at approximately 1 280 m from the noise source, if the noise characteristics are similar. Beyond this distance, the noise level will be below the residual noise and will therefore have little impact. NSA 2 is the closest receptor to a WTG, the distance is 898 m. Therefore, it can be expected that NSA 2 will experience noise levels above 45dB(A). The second closest receptor is NSA 8, at a distance of 1 321m. This receptor will experience noise levels below 47dB(A). All other receptors are located at greater distances and will therefore not be impacted.

The above only applies to the construction noise and light wind conditions. In all likelihood, the construction noise will have little impact on the surrounding community as it will most likely occur during the day when the residual noise is louder and there are unstable atmospheric conditions.

Low frequency noise concerns

The effects of low frequency noise include sleep disturbance, nausea, vertigo etc. These effects are unlikely to impact upon residents due to the distance between the site and the nearest communities. Sources of low frequency noise also include wind and vehicular traffic.

5.2 Predicted noise levels for the Operational Phase

The tables and figures below indicate the isopleths for the noise generated by the turbines at wind speeds of 12 m/s. It must be remembered that as the wind speed increases, so too does the background noise. The modelling results are contained in Table 10 below.

Table 10: Klipkraal WEF 1 Noise Modelling Results

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
NSA 1	6,0	22,3	45	No	35	No
	6,5	22,8	45	No	35	No
	7,0	23,3	45	No	35	No
	7,5	23,8	45	No	35	No
	8,0	24,3	45	No	35	No
	8,5	24,8	45	No	35	No
	9,0	25,3	45	No	35	No
	9,5	25,8	45	No	35	No
	10,0	26,3	45	No	35	No
	10,5	26,8	45	No	35	No
	11,0	27,3	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	11,5	27,8	45	No	35	No
	12,0	28,3	45	No	35	No
NSA 2	6,0	31,3	45	No	35	No
	6,5	31,8	45	No	35	No
	7,0	32,3	45	No	35	No
	7,5	32,8	45	No	35	No
	8,0	33,3	45	No	35	No
	8,5	33,8	45	No	35	No
	9,0	34,3	45	No	35	No
	9,5	34,8	45	No	35	No
	10,0	35,3	45	No	35	Yes
	10,5	35,8	45	No	35	Yes
	11,0	36,3	45	No	35	Yes
	11,5	36,8	45	No	35	Yes
	12,0	37,2	45	No	35	Yes
NSA 3	6,0	4,9	45	No	35	No
	6,5	5,4	45	No	35	No
	7,0	5,9	45	No	35	No
	7,5	6,4	45	No	35	No
	8,0	6,9	45	No	35	No
	8,5	7,4	45	No	35	No
	9,0	7,9	45	No	35	No
	9,5	8,4	45	No	35	No
	10,0	8,9	45	No	35	No
	10,5	9,4	45	No	35	No
	11,0	9,9	45	No	35	No
	11,5	10,4	45	No	35	No
	12,0	10,9	45	No	35	No
NSA 4	6,0	6,0	45	No	35	No
	6,5	6,5	45	No	35	No
	7,0	7,0	45	No	35	No
	7,5	7,5	45	No	35	No
	8,0	8,0	45	No	35	No
	8,5	8,5	45	No	35	No
	9,0	9,0	45	No	35	No
	9,5	9,5	45	No	35	No
	10,0	10,0	45	No	35	No
	10,5	10,5	45	No	35	No
	11,0	11,0	45	No	35	No
	11,5	11,5	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	12,0	45	No	35	No
NSA 5	6,0	6,2	45	No	35	No
	6,5	6,7	45	No	35	No
	7,0	7,2	45	No	35	No
	7,5	7,7	45	No	35	No
	8,0	8,2	45	No	35	No
	8,5	8,7	45	No	35	No
	9,0	9,2	45	No	35	No
	9,5	9,7	45	No	35	No
	10,0	10,2	45	No	35	No
	10,5	10,7	45	No	35	No
	11,0	11,2	45	No	35	No
	11,5	11,7	45	No	35	No
	12,0	12,2	45	No	35	No
NSA 6	6,0	0,0	45	No	35	No
	6,5	0,0	45	No	35	No
	7,0	0,0	45	No	35	No
	7,5	0,0	45	No	35	No
	8,0	0,0	45	No	35	No
	8,5	0,0	45	No	35	No
	9,0	0,1	45	No	35	No
	9,5	0,6	45	No	35	No
	10,0	1,1	45	No	35	No
	10,5	1,6	45	No	35	No
	11,0	2,1	45	No	35	No
	11,5	2,6	45	No	35	No
	12,0	3,1	45	No	35	No
NSA 7	6,0	0,0	45	No	35	No
	6,5	0,0	45	No	35	No
	7,0	0,0	45	No	35	No
	7,5	0,0	45	No	35	No
	8,0	0,0	45	No	35	No
	8,5	0,0	45	No	35	No
	9,0	0,5	45	No	35	No
	9,5	1,0	45	No	35	No
	10,0	1,5	45	No	35	No
	10,5	2,0	45	No	35	No
	11,0	2,5	45	No	35	No
	11,5	3,0	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	3,5	45	No	35	No
NSA 8	6,0	29,5	45	No	35	No
	6,5	30,0	45	No	35	No
	7,0	30,5	45	No	35	No
	7,5	31,0	45	No	35	No
	8,0	31,5	45	No	35	No
	8,5	32,0	45	No	35	No
	9,0	32,5	45	No	35	No
	9,5	33,0	45	No	35	No
	10,0	33,5	45	No	35	No
	10,5	34,0	45	No	35	No
	11,0	34,5	45	No	35	No
	11,5	35,0	45	No	35	No
	12,0	35,4	45	No	35	Yes
NSA 9	6,0	13,6	45	No	35	No
	6,5	14,1	45	No	35	No
	7,0	14,6	45	No	35	No
	7,5	15,1	45	No	35	No
	8,0	15,6	45	No	35	No
	8,5	16,1	45	No	35	No
	9,0	16,6	45	No	35	No
	9,5	17,1	45	No	35	No
	10,0	17,6	45	No	35	No
	10,5	18,1	45	No	35	No
	11,0	18,6	45	No	35	No
	11,5	19,1	45	No	35	No
	12,0	19,6	45	No	35	No
NSA 10	6,0	10,5	45	No	35	No
	6,5	11,0	45	No	35	No
	7,0	11,5	45	No	35	No
	7,5	12,0	45	No	35	No
	8,0	12,5	45	No	35	No
	8,5	13,0	45	No	35	No
	9,0	13,5	45	No	35	No
	9,5	14,0	45	No	35	No
	10,0	14,5	45	No	35	No
	10,5	15,0	45	No	35	No
	11,0	15,5	45	No	35	No
	11,5	16,0	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	16,4	45	No	35	No
NSA 11	6,0	8,0	45	No	35	No
	6,5	8,5	45	No	35	No
	7,0	9,0	45	No	35	No
	7,5	9,5	45	No	35	No
	8,0	10,0	45	No	35	No
	8,5	10,5	45	No	35	No
	9,0	11,0	45	No	35	No
	9,5	11,5	45	No	35	No
	10,0	12,0	45	No	35	No
	10,5	12,5	45	No	35	No
	11,0	13,0	45	No	35	No
	11,5	13,5	45	No	35	No
	12,0	14,0	45	No	35	No
NSA 12	6,0	8,1	45	No	35	No
	6,5	8,6	45	No	35	No
	7,0	9,1	45	No	35	No
	7,5	9,6	45	No	35	No
	8,0	10,1	45	No	35	No
	8,5	10,6	45	No	35	No
	9,0	11,1	45	No	35	No
	9,5	11,6	45	No	35	No
	10,0	12,1	45	No	35	No
	10,5	12,6	45	No	35	No
	11,0	13,1	45	No	35	No
	11,5	13,6	45	No	35	No
	12,0	14,1	45	No	35	No
NSA 13	6,0	11,3	45	No	35	No
	6,5	11,8	45	No	35	No
	7,0	12,3	45	No	35	No
	7,5	12,8	45	No	35	No
	8,0	13,3	45	No	35	No
	8,5	13,8	45	No	35	No
	9,0	14,3	45	No	35	No
	9,5	14,8	45	No	35	No
	10,0	15,3	45	No	35	No
	10,5	15,8	45	No	35	No
	11,0	16,3	45	No	35	No
	11,5	16,8	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	17,3	45	No	35	No
NSA 14	6,0	6,5	45	No	35	No
	6,5	7,0	45	No	35	No
	7,0	7,5	45	No	35	No
	7,5	8,0	45	No	35	No
	8,0	8,5	45	No	35	No
	8,5	9,0	45	No	35	No
	9,0	9,5	45	No	35	No
	9,5	10,0	45	No	35	No
	10,0	10,5	45	No	35	No
	10,5	11,0	45	No	35	No
	11,0	11,5	45	No	35	No
	11,5	12,0	45	No	35	No
	12,0	12,5	45	No	35	No
NSA 15	6,0	4,0	45	No	35	No
	6,5	4,5	45	No	35	No
	7,0	5,0	45	No	35	No
	7,5	5,5	45	No	35	No
	8,0	6,0	45	No	35	No
	8,5	6,5	45	No	35	No
	9,0	7,0	45	No	35	No
	9,5	7,5	45	No	35	No
	10,0	8,0	45	No	35	No
	10,5	8,5	45	No	35	No
	11,0	9,0	45	No	35	No
	11,5	9,5	45	No	35	No
	12,0	10,0	45	No	35	No
NSA 16	6,0	10,6	45	No	35	No
	6,5	11,1	45	No	35	No
	7,0	11,6	45	No	35	No
	7,5	12,1	45	No	35	No
	8,0	12,6	45	No	35	No
	8,5	13,1	45	No	35	No
	9,0	13,6	45	No	35	No
	9,5	14,1	45	No	35	No
	10,0	14,6	45	No	35	No
	10,5	15,1	45	No	35	No
	11,0	15,6	45	No	35	No
	11,5	16,1	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	16,6	45	No	35	No
NSA 17	6,0	3,4	45	No	35	No
	6,5	3,9	45	No	35	No
	7,0	4,4	45	No	35	No
	7,5	4,9	45	No	35	No
	8,0	5,4	45	No	35	No
	8,5	5,9	45	No	35	No
	9,0	6,4	45	No	35	No
	9,5	6,9	45	No	35	No
	10,0	7,4	45	No	35	No
	10,5	7,9	45	No	35	No
	11,0	8,4	45	No	35	No
	11,5	8,9	45	No	35	No
	12,0	9,4	45	No	35	No
NSA 18	6,0	4,6	45	No	35	No
	6,5	5,1	45	No	35	No
	7,0	5,6	45	No	35	No
	7,5	6,1	45	No	35	No
	8,0	6,6	45	No	35	No
	8,5	7,1	45	No	35	No
	9,0	7,6	45	No	35	No
	9,5	8,1	45	No	35	No
	10,0	8,6	45	No	35	No
	10,5	9,1	45	No	35	No
	11,0	9,6	45	No	35	No
	11,5	10,1	45	No	35	No
	12,0	10,6	45	No	35	No
NSA 19	6,0	2,3	45	No	35	No
	6,5	2,8	45	No	35	No
	7,0	3,3	45	No	35	No
	7,5	3,8	45	No	35	No
	8,0	4,3	45	No	35	No
	8,5	4,8	45	No	35	No
	9,0	5,3	45	No	35	No
	9,5	5,8	45	No	35	No
	10,0	6,3	45	No	35	No
	10,5	6,8	45	No	35	No
	11,0	7,3	45	No	35	No
	11,5	7,8	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	8,3	45	No	35	No
NSA 20	6,0	1,1	45	No	35	No
	6,5	1,6	45	No	35	No
	7,0	2,1	45	No	35	No
	7,5	2,6	45	No	35	No
	8,0	3,1	45	No	35	No
	8,5	3,6	45	No	35	No
	9,0	4,1	45	No	35	No
	9,5	4,6	45	No	35	No
	10,0	5,1	45	No	35	No
	10,5	5,6	45	No	35	No
	11,0	6,1	45	No	35	No
	11,5	6,6	45	No	35	No
	12,0	7,1	45	No	35	No
NSA 21	6,0	8,0	45	No	35	No
	6,5	8,5	45	No	35	No
	7,0	9,0	45	No	35	No
	7,5	9,5	45	No	35	No
	8,0	10,0	45	No	35	No
	8,5	10,5	45	No	35	No
	9,0	11,0	45	No	35	No
	9,5	11,5	45	No	35	No
	10,0	12,0	45	No	35	No
	10,5	12,5	45	No	35	No
	11,0	13,0	45	No	35	No
	11,5	13,5	45	No	35	No
	12,0	14,0	45	No	35	No
NSA 22	6,0	8,2	45	No	35	No
	6,5	8,7	45	No	35	No
	7,0	9,2	45	No	35	No
	7,5	9,7	45	No	35	No
	8,0	10,2	45	No	35	No
	8,5	10,7	45	No	35	No
	9,0	11,2	45	No	35	No
	9,5	11,7	45	No	35	No
	10,0	12,2	45	No	35	No
	10,5	12,7	45	No	35	No
	11,0	13,2	45	No	35	No
	11,5	13,7	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	14,2	45	No	35	No
NSA 23	6,0	2,4	45	No	35	No
	6,5	2,9	45	No	35	No
	7,0	3,4	45	No	35	No
	7,5	3,9	45	No	35	No
	8,0	4,4	45	No	35	No
	8,5	4,9	45	No	35	No
	9,0	5,4	45	No	35	No
	9,5	5,9	45	No	35	No
	10,0	6,4	45	No	35	No
	10,5	6,9	45	No	35	No
	11,0	7,4	45	No	35	No
	11,5	7,9	45	No	35	No
	12,0	8,4	45	No	35	No

Figure 8 below shows the predicted noise levels visually.

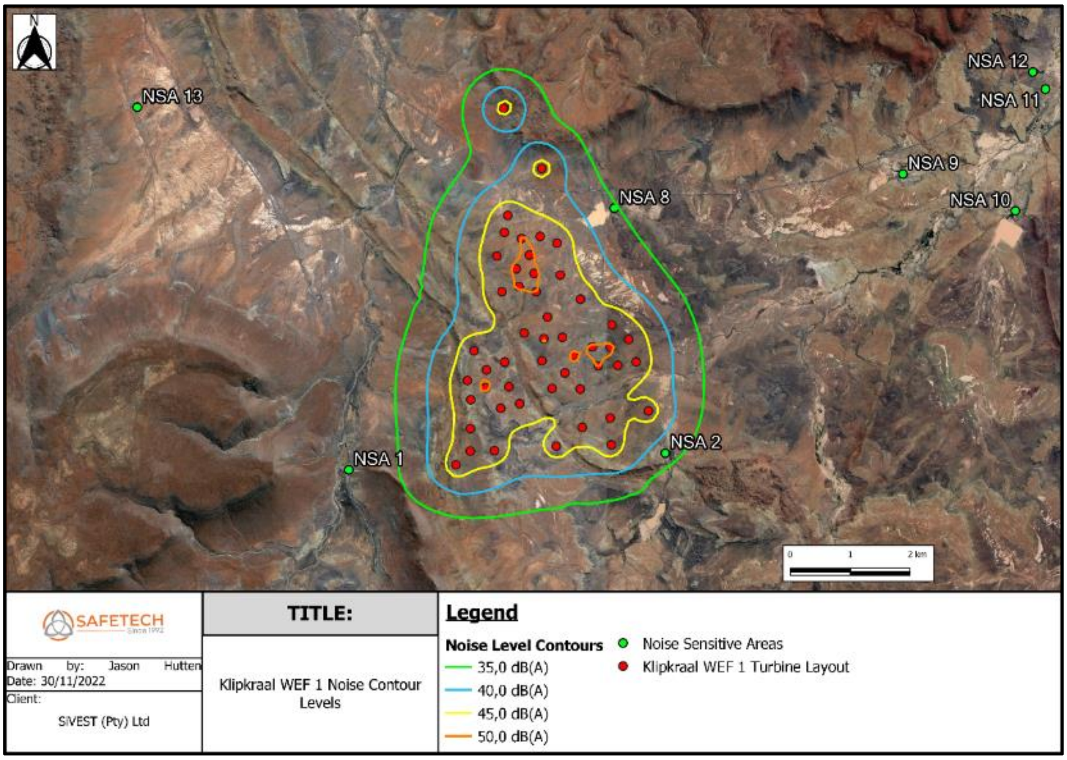


Figure 8: Predicted Noise Levels from WTGs (at 12m/s wind speed)

Figure 9 below shows the noise level contours when the WTGs are operating at lower wind speeds (6m/s). at these speeds, the wind masking effects may not be as prominent.

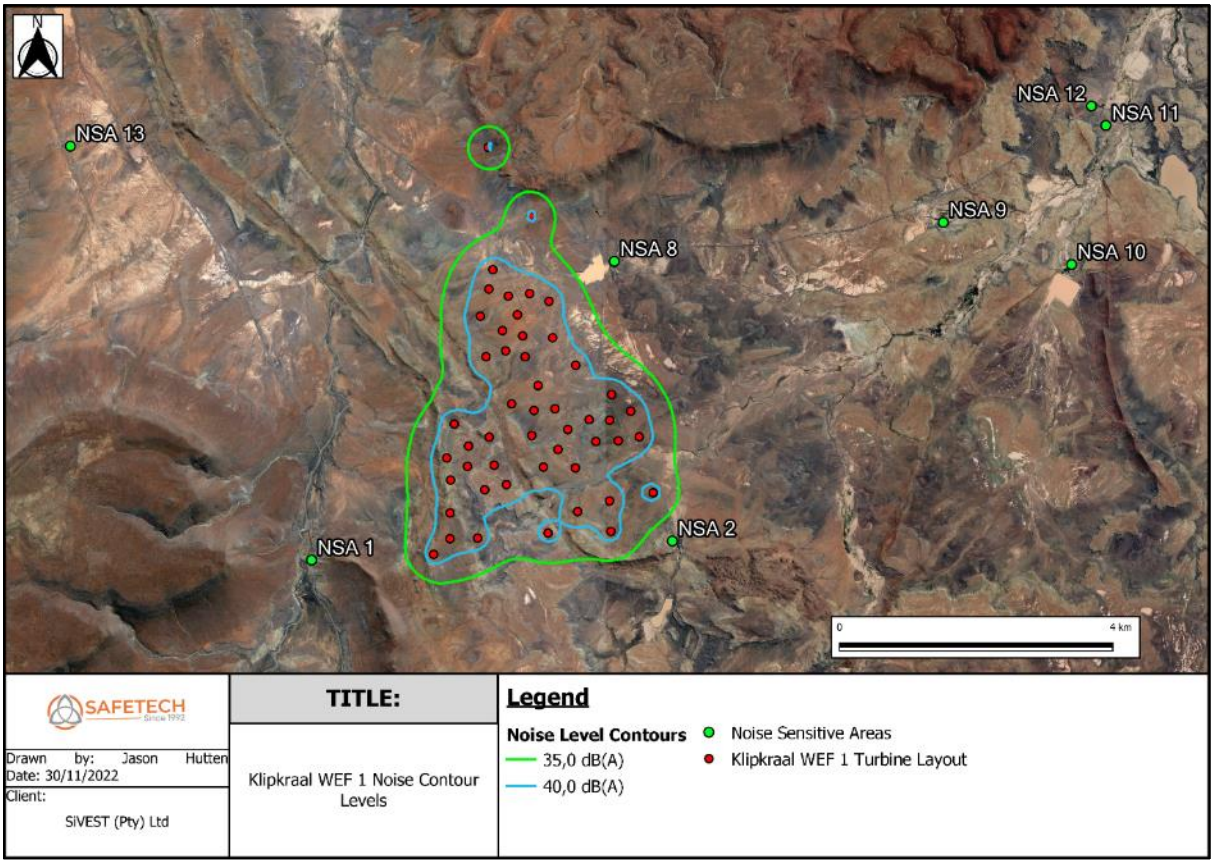


Figure 9: Predicted Noise Levels from WTGs (at 6m/s wind speed)

5.3 Predicted noise levels during the decommissioning phase

The noise levels experienced during the decommissioning phase of the project will be similar to the construction phase. Therefore, it is likely that the impacts, from a noise perspective, will be low. Furthermore, a “no-go” alternative was not assessed as there will be no noise impact if the site is not developed.

5.4 Cumulative Noise Impacts

The proposed windfarm is located adjacent to two other renewable energy facilities, in the Environmental Authorization Phase, within a 35 km radius. Klipkraal WEF 2 and Klipkraal 3 have been assessed together with Klipkraal WEF 1 to determine the cumulative noise levels that are predicted during the operational phase.

Figure 10 below illustrates the location of the surrounding developments.

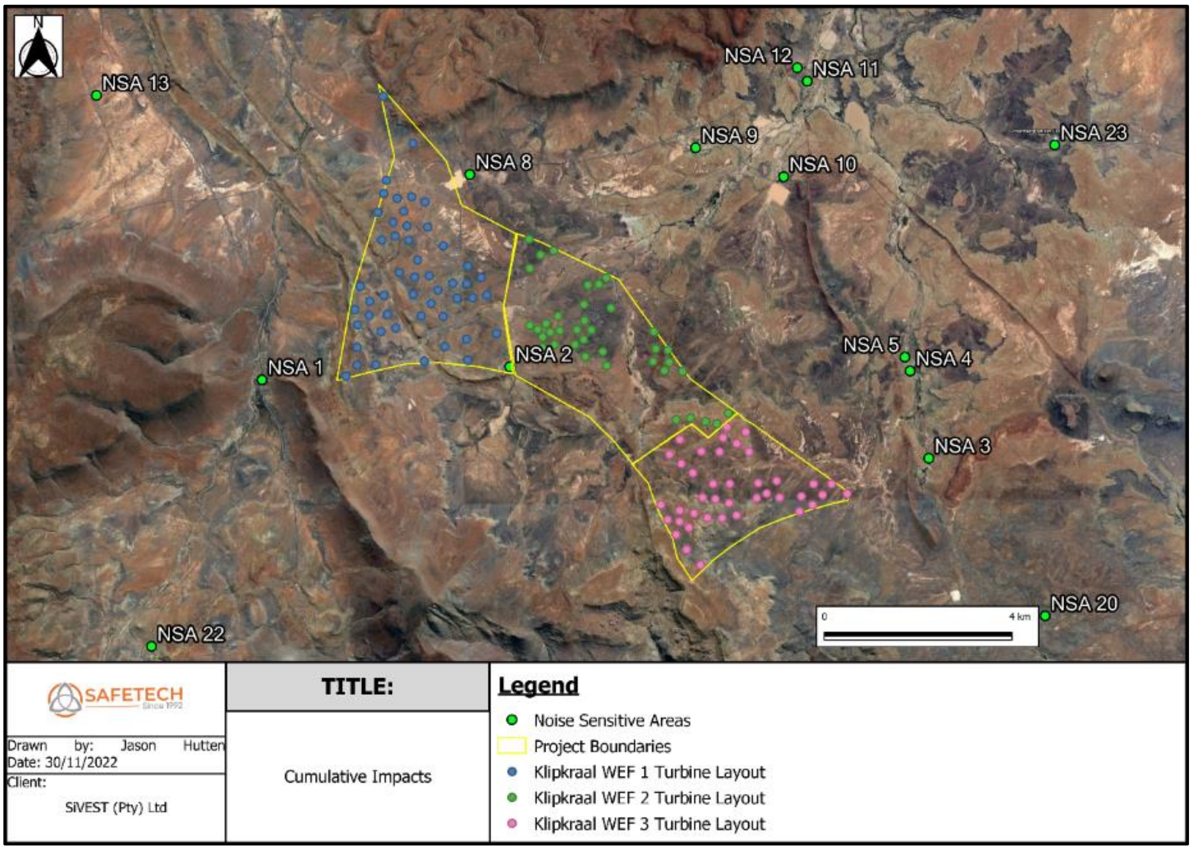


Figure 10: Klipkraal WEF 1, 2 and 3 turbines considered for cumulative impact noise modelling

The predicted cumulative noise levels from the operation of all three Klipkraal WEFs was modelled to determine the cumulative impacts on identified NSAs, the summary of the results can be seen in Table 11 below. These results indicate the maximum noise levels that may be experienced at each NSA, usually occurring at higher wind speeds where wind masking is likely to occur.

Table 11: Cumulative Noise Modelling Results

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
NSA 1	6,0	22,7	45	No	35	No
	6,5	23,2	45	No	35	No
	7,0	23,7	45	No	35	No
	7,5	24,2	45	No	35	No
	8,0	24,7	45	No	35	No
	8,5	25,2	45	No	35	No
	9,0	25,7	45	No	35	No
	9,5	26,2	45	No	35	No
	10,0	26,7	45	No	35	No
	10,5	27,2	45	No	35	No
	11,0	27,7	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	11,5	28,2	45	No	35	No
	12,0	28,7	45	No	35	No
NSA 2	6,0	36,6	45	No	35	Yes
	6,5	37,1	45	No	35	Yes
	7,0	37,6	45	No	35	Yes
	7,5	38,1	45	No	35	Yes
	8,0	38,6	45	No	35	Yes
	8,5	39,1	45	No	35	Yes
	9,0	39,6	45	No	35	Yes
	9,5	40,1	45	No	35	Yes
	10,0	40,6	45	No	35	Yes
	10,5	41,1	45	No	35	Yes
	11,0	41,6	45	No	35	Yes
	11,5	42,1	45	No	35	Yes
	12,0	42,6	45	No	35	Yes
NSA 3	6,0	21,8	45	No	35	No
	6,5	22,3	45	No	35	No
	7,0	22,8	45	No	35	No
	7,5	23,3	45	No	35	No
	8,0	23,8	45	No	35	No
	8,5	24,3	45	No	35	No
	9,0	24,8	45	No	35	No
	9,5	25,3	45	No	35	No
	10,0	25,8	45	No	35	No
	10,5	26,3	45	No	35	No
	11,0	26,8	45	No	35	No
	11,5	27,3	45	No	35	No
	12,0	27,8	45	No	35	No
NSA 4	6,0	19,5	45	No	35	No
	6,5	20,0	45	No	35	No
	7,0	20,5	45	No	35	No
	7,5	21,0	45	No	35	No
	8,0	21,5	45	No	35	No
	8,5	22,0	45	No	35	No
	9,0	22,5	45	No	35	No
	9,5	23,0	45	No	35	No
	10,0	23,5	45	No	35	No
	10,5	24,0	45	No	35	No
	11,0	24,5	45	No	35	No
	11,5	25,0	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	25,5	45	No	35	No
NSA 5	6,0	19,3	45	No	35	No
	6,5	19,8	45	No	35	No
	7,0	20,3	45	No	35	No
	7,5	20,8	45	No	35	No
	8,0	21,3	45	No	35	No
	8,5	21,8	45	No	35	No
	9,0	22,3	45	No	35	No
	9,5	22,8	45	No	35	No
	10,0	23,3	45	No	35	No
	10,5	23,8	45	No	35	No
	11,0	24,3	45	No	35	No
	11,5	24,8	45	No	35	No
	12,0	25,3	45	No	35	No
NSA 6	6,0	6,1	45	No	35	No
	6,5	6,6	45	No	35	No
	7,0	7,1	45	No	35	No
	7,5	7,6	45	No	35	No
	8,0	8,1	45	No	35	No
	8,5	8,6	45	No	35	No
	9,0	9,1	45	No	35	No
	9,5	9,6	45	No	35	No
	10,0	10,1	45	No	35	No
	10,5	10,6	45	No	35	No
	11,0	11,1	45	No	35	No
	11,5	11,6	45	No	35	No
	12,0	12,1	45	No	35	No
NSA 7	6,0	6,5	45	No	35	No
	6,5	7,0	45	No	35	No
	7,0	7,5	45	No	35	No
	7,5	8,0	45	No	35	No
	8,0	8,5	45	No	35	No
	8,5	9,0	45	No	35	No
	9,0	9,5	45	No	35	No
	9,5	10,0	45	No	35	No
	10,0	10,5	45	No	35	No
	10,5	11,0	45	No	35	No
	11,0	11,5	45	No	35	No
	11,5	12,0	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	12,5	45	No	35	No
NSA 8	6,0	30,1	45	No	35	No
	6,5	30,6	45	No	35	No
	7,0	31,1	45	No	35	No
	7,5	31,6	45	No	35	No
	8,0	32,1	45	No	35	No
	8,5	32,6	45	No	35	No
	9,0	33,1	45	No	35	No
	9,5	33,6	45	No	35	No
	10,0	34,1	45	No	35	No
	10,5	34,6	45	No	35	No
	11,0	35,1	45	No	35	Yes
	11,5	35,6	45	No	35	Yes
	12,0	36,1	45	No	35	Yes
NSA 9	6,0	20,0	45	No	35	No
	6,5	20,5	45	No	35	No
	7,0	21,0	45	No	35	No
	7,5	21,5	45	No	35	No
	8,0	22,0	45	No	35	No
	8,5	22,5	45	No	35	No
	9,0	23,0	45	No	35	No
	9,5	23,5	45	No	35	No
	10,0	24,0	45	No	35	No
	10,5	24,5	45	No	35	No
	11,0	25,0	45	No	35	No
	11,5	25,5	45	No	35	No
	12,0	25,9	45	No	35	No
NSA 10	6,0	18,3	45	No	35	No
	6,5	18,8	45	No	35	No
	7,0	19,3	45	No	35	No
	7,5	19,8	45	No	35	No
	8,0	20,3	45	No	35	No
	8,5	20,8	45	No	35	No
	9,0	21,3	45	No	35	No
	9,5	21,8	45	No	35	No
	10,0	22,3	45	No	35	No
	10,5	22,8	45	No	35	No
	11,0	23,3	45	No	35	No
	11,5	23,8	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	24,3	45	No	35	No
NSA 11	6,0	14,1	45	No	35	No
	6,5	14,6	45	No	35	No
	7,0	15,1	45	No	35	No
	7,5	15,6	45	No	35	No
	8,0	16,1	45	No	35	No
	8,5	16,6	45	No	35	No
	9,0	17,1	45	No	35	No
	9,5	17,6	45	No	35	No
	10,0	18,1	45	No	35	No
	10,5	18,6	45	No	35	No
	11,0	19,1	45	No	35	No
	11,5	19,6	45	No	35	No
	12,0	20,1	45	No	35	No
NSA 12	6,0	13,9	45	No	35	No
	6,5	14,4	45	No	35	No
	7,0	14,9	45	No	35	No
	7,5	15,4	45	No	35	No
	8,0	15,9	45	No	35	No
	8,5	16,4	45	No	35	No
	9,0	16,9	45	No	35	No
	9,5	17,4	45	No	35	No
	10,0	17,9	45	No	35	No
	10,5	18,4	45	No	35	No
	11,0	18,9	45	No	35	No
	11,5	19,4	45	No	35	No
	12,0	19,9	45	No	35	No
NSA 13	6,0	12,3	45	No	35	No
	6,5	12,8	45	No	35	No
	7,0	13,3	45	No	35	No
	7,5	13,8	45	No	35	No
	8,0	14,3	45	No	35	No
	8,5	14,8	45	No	35	No
	9,0	15,3	45	No	35	No
	9,5	15,8	45	No	35	No
	10,0	16,3	45	No	35	No
	10,5	16,8	45	No	35	No
	11,0	17,3	45	No	35	No
	11,5	17,8	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	18,3	45	No	35	No
NSA 14	6,0	7,9	45	No	35	No
	6,5	8,4	45	No	35	No
	7,0	8,9	45	No	35	No
	7,5	9,4	45	No	35	No
	8,0	9,9	45	No	35	No
	8,5	10,4	45	No	35	No
	9,0	10,9	45	No	35	No
	9,5	11,4	45	No	35	No
	10,0	11,9	45	No	35	No
	10,5	12,4	45	No	35	No
	11,0	12,9	45	No	35	No
	11,5	13,4	45	No	35	No
	12,0	13,9	45	No	35	No
NSA 15	6,0	5,8	45	No	35	No
	6,5	6,3	45	No	35	No
	7,0	6,8	45	No	35	No
	7,5	7,3	45	No	35	No
	8,0	7,8	45	No	35	No
	8,5	8,3	45	No	35	No
	9,0	8,8	45	No	35	No
	9,5	9,3	45	No	35	No
	10,0	9,8	45	No	35	No
	10,5	10,3	45	No	35	No
	11,0	10,8	45	No	35	No
	11,5	11,3	45	No	35	No
	12,0	11,8	45	No	35	No
NSA 16	6,0	11,7	45	No	35	No
	6,5	12,2	45	No	35	No
	7,0	12,7	45	No	35	No
	7,5	13,2	45	No	35	No
	8,0	13,7	45	No	35	No
	8,5	14,2	45	No	35	No
	9,0	14,7	45	No	35	No
	9,5	15,2	45	No	35	No
	10,0	15,7	45	No	35	No
	10,5	16,2	45	No	35	No
	11,0	16,7	45	No	35	No
	11,5	17,2	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	17,7	45	No	35	No
NSA 17	6,0	6,4	45	No	35	No
	6,5	6,9	45	No	35	No
	7,0	7,4	45	No	35	No
	7,5	7,9	45	No	35	No
	8,0	8,4	45	No	35	No
	8,5	8,9	45	No	35	No
	9,0	9,4	45	No	35	No
	9,5	9,9	45	No	35	No
	10,0	10,4	45	No	35	No
	10,5	10,9	45	No	35	No
	11,0	11,4	45	No	35	No
	11,5	11,9	45	No	35	No
	12,0	12,4	45	No	35	No
NSA 18	6,0	7,2	45	No	35	No
	6,5	7,7	45	No	35	No
	7,0	8,2	45	No	35	No
	7,5	8,7	45	No	35	No
	8,0	9,2	45	No	35	No
	8,5	9,7	45	No	35	No
	9,0	10,2	45	No	35	No
	9,5	10,7	45	No	35	No
	10,0	11,2	45	No	35	No
	10,5	11,7	45	No	35	No
	11,0	12,2	45	No	35	No
	11,5	12,7	45	No	35	No
	12,0	13,2	45	No	35	No
NSA 19	6,0	13,0	45	No	35	No
	6,5	13,5	45	No	35	No
	7,0	14,0	45	No	35	No
	7,5	14,5	45	No	35	No
	8,0	15,0	45	No	35	No
	8,5	15,5	45	No	35	No
	9,0	16,0	45	No	35	No
	9,5	16,5	45	No	35	No
	10,0	17,0	45	No	35	No
	10,5	17,5	45	No	35	No
	11,0	18,0	45	No	35	No
	11,5	18,5	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	19,0	45	No	35	No
NSA 20	6,0	13,1	45	No	35	No
	6,5	13,6	45	No	35	No
	7,0	14,1	45	No	35	No
	7,5	14,6	45	No	35	No
	8,0	15,1	45	No	35	No
	8,5	15,6	45	No	35	No
	9,0	16,1	45	No	35	No
	9,5	16,6	45	No	35	No
	10,0	17,1	45	No	35	No
	10,5	17,6	45	No	35	No
	11,0	18,1	45	No	35	No
	11,5	18,6	45	No	35	No
	12,0	19,1	45	No	35	No
NSA 21	6,0	12,4	45	No	35	No
	6,5	12,9	45	No	35	No
	7,0	13,4	45	No	35	No
	7,5	13,9	45	No	35	No
	8,0	14,4	45	No	35	No
	8,5	14,9	45	No	35	No
	9,0	15,4	45	No	35	No
	9,5	15,9	45	No	35	No
	10,0	16,4	45	No	35	No
	10,5	16,9	45	No	35	No
	11,0	17,4	45	No	35	No
	11,5	17,9	45	No	35	No
	12,0	18,4	45	No	35	No
NSA 22	6,0	10,4	45	No	35	No
	6,5	10,9	45	No	35	No
	7,0	11,4	45	No	35	No
	7,5	11,9	45	No	35	No
	8,0	12,4	45	No	35	No
	8,5	12,9	45	No	35	No
	9,0	13,4	45	No	35	No
	9,5	13,9	45	No	35	No
	10,0	14,4	45	No	35	No
	10,5	14,9	45	No	35	No
	11,0	15,4	45	No	35	No
	11,5	15,9	45	No	35	No

Receptor Name	Wind speed (m/s)	Noise Levels from WTG (dBA)	Day time Noise Rating Limit (dBA)	Is the Day time Limit Exceeded?	Night time Noise Rating Limit (dBA)	Is the Night time Limit Exceeded?
	12,0	16,3	45	No	35	No
NSA 23	6,0	10,0	45	No	35	No
	6,5	10,5	45	No	35	No
	7,0	11,0	45	No	35	No
	7,5	11,5	45	No	35	No
	8,0	12,0	45	No	35	No
	8,5	12,5	45	No	35	No
	9,0	13,0	45	No	35	No
	9,5	13,5	45	No	35	No
	10,0	14,0	45	No	35	No
	10,5	14,5	45	No	35	No
	11,0	15,0	45	No	35	No
	11,5	15,5	45	No	35	No
	12,0	16,0	45	No	35	No

The results above indicate that at no time will the noise levels experienced at the relevant NSAs be above the SANS 10103:2008 day time limits as a result of all three Klipkraal WEFs being in operation simultaneously. However, the SANS Night Time Rating will be exceeded at NSA 2 and NSA 8. The exceedances are likely to have little impact as the wind will create a masking effect.

The cumulative impacts can therefore be expected to be of low significance.

6. Impact Assessment

The "no-go" alternative was not assessed as there will be no noise impact if the site is not developed. The potential impacts during the construction, operational, and decommissioning phases are discussed below. Each subsection summarizes the potential impacts. The Impact Rating Table in subsection 6.5 shows the significance of the impacts at each phase.

6.1 Potential Impacts during the Construction Phase

The following can potential impacts have been identified:

- There will be an impact on the immediate surrounding environment from the construction activities, especially if pile driving is to be done. This, however, will only occur if the underlying geological structure requires piling.
- The area surrounding the construction site will be affected for a short period of time in all directions by construction noise impacts, should several pieces of construction equipment be used simultaneously.
- The number of construction vehicles that will be used in the project will add to the existing residual levels and will most likely cause a disturbing noise, albeit for a short period of time.

In conclusion, there will be a short-term increase in noise in the vicinity of the site during the construction phase as the residual noise level will be exceeded. The impact during the construction phase will be difficult to mitigate. The significance of the construction noise impact is predicted to be low (before and after mitigation).

The following mitigation measures are recommended for construction activities:

- All construction operations should only occur during daylight hours, if possible.
- No construction piling should occur at night. Piling should only occur during the hottest part of the day to take advantage of unstable atmospheric conditions.
- Construction staff should be given “noise sensitivity” training to mitigate the noise impacts caused during construction as well as noise protective gear.

6.2 Potential Impacts during the Operational Phase

The residual noise increases as the wind speed increases and the wind noise masking effect increases i.e. the audible noise from the wind farm becomes less as wind noise masking increases. Under very stable atmospheric conditions, a temperature inversion or a light wind, the turbines will in all likelihood not be operational as the cut-in speed is 3 m/s. As the wind speed increases above the cut-in speed the residual noise will also increase. If the atmospheric conditions are such that the wind is very light (<3 m/s), at ground level, but the wind speed exceeds the cut-in speed at hub height, then the turbines will begin to operate. It is thus feasible that little noise masking will occur at this low windspeed. The critical wind speeds are thus between 3-5 m/s at hub height when there may be little possibility of masking at ground level.

The noise modelling indicates that the noise levels from the turbines will be below the SANS 10103:2008 day time limits for rural areas at all NSA's. Exceedances of the SANS 10103:2008 night time limits may occur at NSA 2 and NSA 8.

The summary of the predicted noise levels for the two affected NSAs can be seen in Table 12 below. The modelled noise at these receptors from the turbines above 6m/s will in all likelihood be masked by the surface wind noise. The significance of the potential noise impacts during the operational phase were assessed to be **low** before mitigation.

Table 12: NSAs exceeding SANS 10103 Night Time Limits

NSA Name	Maximum Level of Noise Exposure (dB[A])
NSA 2	37.2
NSA 8	35.4

6.3 Potential Impacts during the Decommissioning Phase

During the de-commissioning phase, the noise impacts will be the same as the construction phase.

6.4 Cumulative Impacts

Klipkraal WEF 1-3 have been assessed for cumulative impacts as all other projects within a 35 km radius are too far away to have an impact, from a noise perspective, on the identified NSAs.

Table 13 below shows the NSAs that may experience an exceedance of SANS 10103:2008 night time noise limits from the operation of only turbines on Klipkraal WEF 1 and compares them to the cumulative noise levels from all three Klipkraal WEFs.

Table 13: Noise Levels Exceeding SANS Night time Limits due to Cumulative Impacts

NSA Name	Maximum Level of Noise Exposure (dB[A])
NSA 2	42.6
NSA 8	36.1

6.5 Impact Assessment Summary

Table 14 below shows the overall impact significance findings, following the implementation of the proposed mitigation measures. The Impact Rating Methodology was supplied by SiVEST and is attached in Annexure C

Table 14: Impact Rating Methodology Summary

Klipkraal Wind Energy Facility 1																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Noise emissions during the Construction Phase	Noise Pollution due to construction activities (equipment and vehicle noise)	2	1	1	1	1	1	6	-	Low	1. Staff to receive training on noise sensitivity. 2. Monitoring of noise during the construction phase to confirm noise levels are within limits. 3. Limit construction to day time in order to take advantage of unstable weather conditions. 4. Regularly service equipment to ensure no unnecessary noise is emitted.	2	1	1	1	1	1	6	-	Low
Operational Phase																				
Noise emissions during the Operational Phase (Day time)	Mechanical and aerodynamic noise from the operation of the wind turbine components	2	1	1	1	3	1	8	-	Low	1. Conduct noise monitoring during the operational to determine actual noise impacts and whether further mitigations measures need to be implemented such as running the turbines in low power mode at certain wind speeds at night. 2. Implement a 500m "no-go" buffer around all NSAs to ensure no wind turbines impacts these sensitive receptors	2	1	1	1	3	1	8	-	Low

Klipkraal Wind Energy Facility 1

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Noise emissions during the Operational Phase (Night time)	Mechanical and aerodynamic noise from the operation of the wind turbine components	2	1	1	1	3	2	16	-	Low		2	1	1	1	3	1	8	-	Low
Decommissioning Phase																				
Noise emission during the decommissioning phase	Noise Pollution similar to construction activities (equipment and vehicle noise)	2	1	1	1	1	1	6	-	Low	1. Staff to receive training on noise sensitivity. 2. Monitoring of noise during the construction phase to confirm noise levels are within limits. 3. Limit construction to day time in order to take advantage of unstable weather conditions. 4. Regularly service equipment to ensure no unnecessary noise is emitted.	2	1	1	1	1	1	6	-	Low

SAFETECH

Klipkraal Wind Energy Facility 1																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Cumulative																				
Noise emissions from the cumulative effect of all three Klipkraal WEFs operating simultaneously	Mechanical and aerodynamic noise from the operation of the wind turbine components from all three Klipkraal WEFs	2	1	1	1	3	2	16	-	Low	1. Conduct noise monitoring during the operational to determine actual noise impacts and whether further mitigations measures need to be implemented such as running the turbines in low power mode at certain wind speeds at night. 2. Implement a 500m "no-go" buffer around all NSAs to ensure no wind turbines impacts these sensitive receptors	2	1	1	1	3	1	8	-	Low

7. Legislative Guidelines and Requirements

The following standards and regulatory frameworks have been used to aid this study and guide the decision-making process with regards to noise pollution:

- GNR.154 of January 1992: Noise control regulations in terms of section 25 of the Environment Conservation Act (ECA), 1989 (Act No. 73 of 1989);
- South Africa - National Environmental Management Act, 107 OF 1998 - Procedures for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes in terms of Sections 24(5)(a) and

(h) and 44 of the Act when applying for Environmental Authorisation" – GN 320 of 20th March 2020. Page 53 – 56 Section on Noise.

- GNR.155 of 10 January 1992: Application of noise control regulations made under section 25 of the Environment Conservation Act, 1989 (Act No. 73 of 1989);
- SANS 10103:2008 Version 6 - The measurement and rating of environmental noise with respect to annoyance and to speech communication;
- SANS 10357:2004 Version 2.1 - The calculation of sound propagation by the Concawe method;
- ISO 9613-1: Attenuation of sound during propagation outdoors, Part 1: Calculation of sound by the atmosphere;
- ISO 9613-2: Attenuation of sound during propagation outdoors, Part 2: General method of calculation and;
- SANS 10328:2008 - Methods for environmental noise impact assessments.
- SANS 10210:2004 Edition 2.2 – Calculating and predicting road traffic noise

Furthermore, SANS 10103:2008 provides typical rating levels for noise in various types of districts, as described in Table 15 below.

Table 15: Typical rating levels for noise in various types of districts

Type of District	Equivalent Continuous Rating Level, LReq.T for Noise					
	Outdoors (dB(A))			Indoors, with open windows (dB(A))		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
Rural Districts	45	45	35	35	35	25
Suburban districts with little road traffic	50	50	40	40	40	30
Urban districts	55	55	45	45	45	35
Urban districts with one or more of the following: Workshops; business premises and main roads	60	60	50	50	50	40
Central business districts	65	65	55	55	55	45
Industrial districts	70	70	60	60	60	50

The proposed development is situated in rural district. This implies that the noise levels in the area should not exceed 45 dB(A) during the day (06:00 to 22:00) and not exceed 35 dB(A) during the night-time hours (22:00 to 06:00) when standing outdoors. Noise levels predicted for each NSA can be considered as outdoor levels as the model does not take buildings and barriers into account.

These rating levels can be seen as the target levels for any noise emissions arising from the construction and operation of the proposed development.

SANS 10103:2008 also provides a guideline for expected community responses to excess environmental noise above the residual noise. These are reflected in Table 16 below.

Table 16: Expected community response to excess noise levels

Excess ($\Delta L_{Req,T}$)	Estimated community/group response	
	Category	Description
0 - 10	Little	Sporadic complaints
5 - 15	Medium	Widespread complaints
10 - 20	Strong	Threats of community / group action
> 15	Very Strong	Vigorous community / group action

NOTE: Overlapping ranges for the excess values are given because a spread in the community reaction might be anticipated.
The ΔL_{ReqT} should be calculated from the appropriate of the following options:
1) $\Delta L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the residual noise (determined in the absence of the specific noise under investigation);
2) $\Delta L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1 of SANS 10103:2008;
3) $\Delta L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the typical rating level for the applicable district as determined from table 2 of SANS 10103:2008; or
4) $\Delta L_{Req,T}$ = Expected increase in $L_{Req,T}$ of ambient noise in an area because of a proposed development under investigation.

There are no legal permits or licenses required that are related to noise emissions.

The modelling results show that the night time noise rating limit of 35dB(A) will be exceeded at NSA 2 and NSA 8 above 10m/s windspeed and sporadic complaints could be expected as per Table 16 above. It is however expected that there may be wind noise masking at this windspeed which will mitigate the impact such that complaints may not be received.

8. Environmental Management Programme Inputs

Table 17 and 18 below outline the recommended mitigation actions to be included in the Environmental Management Programme (EMPr).

Table 17: Monitoring and Mitigation Actions for input into EMPr (Construction Phase)

Impact/Aspect	**Mitigation/Management Actions**	***Responsibility***	***Methodology***	**Mitigation/Management Objectives and Outcomes**	***Frequency***
Reduce construction noise	Conduct noise sensitivity training for all construction staff. No construction piling should occur at night. Piling should only occur during the hottest part of the day to take advantage of unstable atmospheric conditions	Holder of the EA	Training	Reduction in Noise and thus reduction in chance of complaints arising	Before construction commences
Monitor construction noise	Ambient noise monitoring to be conducted.	Specialist noise consultant	As per the requirements of SANS 10103:2008	Validation of Noise Impact Assessment Findings to determine if further noise mitigation is required.	Three times during the construction phase

Table 18: Monitoring and Mitigation Actions for input into EMPr (Operational Phase)

Impact/Aspect	**Mitigation/Management Actions**	***Responsibility***	***Methodology***	**Mitigation/Management Objectives and Outcomes**	***Frequency***
Reduce operational noise	Ambient noise monitoring to be conducted at NSA 2 and NSA 8 when operations commence to verify the noise emissions meet the night time noise rating limit. Mitigation measures to be implemented if the noise impact exceeds the 35dB(A) night noise rating limit such as running the turbines in low power mode at certain wind speeds at night.	Specialist Noise Consultant	As per SANS 10103:2008	Reduction in Noise and thus reduction in chance of complaints arising	Once off during project operations

Mitigation measures for the decommissioning phase will be the same as for the construction phase.

9. Final Specialist Statement and Authorisation Recommendation

9.1 Statement and Reasoned Opinion

Based on the modelling results, the impact will be low from a noise perspective. It is recommended that the development receives environmental authorisation.

9.2 EA Condition Recommendations

The conditions as contained in the EMPr should be included in the environmental authorisation.

References

- Australia Environmental Protect Agency - Wind farms - environmental noise guidelines. July 2009.
- International Finance Corporation – 2007 General EHS Guidelines: Environmental Noise.
- ISO 9613-2 - Acoustics – Attenuation of sound during propagation outdoors. Part 2 – General method of calculation.
- Renewable Energy Research Laboratory - Department of Mechanical and Industrial Engineering. University of Massachusetts at Amherst. A White Paper on Wind Turbine Acoustic Noise. Authors: Anthony L. Rogers, Ph.D. James F. Manwell, Ph.D. Sally Wright. Amended January 2006
- South Africa - GNR.154 of January 1992: Noise control regulations in terms of section 25 of the Environment Conservation Act (ECA), 1989 (Act No. 73 of 1989)
- South Africa - GNR.155 of 10 January 1992: Application of noise control regulations made under section 25 of the Environment Conservation Act, 1989 (Act No. 73 of 1989)
- South Africa - SANS 10210:2004 Edition 2.2 – Calculating and predicting road traffic noise
- South Africa - SANS 10357:2004 Version 2.1 - The calculation of sound propagation by the Concawe method
- South Africa - SANS 10103:2008 Version 6 - The measurement and rating of environmental noise with respect to annoyance and to speech communication.
- Swedish Environmental Protection Agency – Noise Annoyance from Wind Turbines – a Review. Authors: Eja Pedersen, Högskolan i Halmstad. August 2003.
- University of Groningen - 11th International Meeting on Low Frequency Noise and Vibration and its Control. Do wind turbines produce significant low frequency sound levels? GP. van den Berg. September 2003.
- World Health Organization – Guidelines for Community Noise. 1999
- Larom, D, Garstang, M., Payne, K., Raspet, R. & Lindeque, M. 1997. The Journal of Experimental Biology 200, 421–431.
- Wagner, S., Bareib, R. and Guidati, G., Wind Turbine Noise, Springer, Berlin, 1996
- Moraleda, Victoria & Pliego Marugán, Alberto & García Márquez, Fausto Pedro. (2019). Acoustic Maintenance Management Employing Unmanned Aerial Vehicles in Renewable Energies. 10.1007/978-3-319-93351-1_76.

Annexure

Annexure A: Specialist Expertise

SPECIALIST EXPERTISE

(RELATING TO NOISE)

Dr Brett Williams

Name of Organization: Safetech
Position in Firm: Owner
Date of Birth: 21/04/1963
Years with Firm: 29
Nationality: South African

MEMBERSHIP OF PROFESSIONAL BODIES

• Occupational Hygienist Registered with the Southern African Institute of Occupational Hygienists (Registration Number 0221).

BIOGRAPHICAL SKETCH

Brett Williams has been involved in Health, Safety and Environmental Management since 1987. He has been measuring noise related impacts since 1996. Brett is the owner of Safetech who have offices in Pretoria and Port Elizabeth. He has consulted to many different industries including, mining, chemical, automotive, food production etc.

He is registered with the Department of Employment and Labour as well as the Chamber of Mines to measure environmental stressors, which include chemical monitoring, noise and other physical stresses.

PROJECT EXPERIENCE

Brett has conducted various projects to assess environmental noise impacts. The list below presents a selection of his project experience, relevant to noise:

• CES – Coega SEZ Floating Power Barge (Gas to Power)
• SRK – Coega SEZ Zone 13 and Zone 10 North and Zone 10 South (Gas to Power)
• SRK – Engie SEZ Zone 13 (Gas to Power)
• SLR Consulting – Atlantis Azura (Gas to Power)
• SiVest – Oya Hybrid Energy Facility
• Arcus Gibb – Kouga Wind Energy Project
• CSIR – Umgeni Water Desalination Plant
• CSIR – Saldanha Desalination Plant
• CSIR – Atlantis Gas to Power Project (current)
• CSIR – Walvis Bay Port Extension
• CSIR – Noise Impact Study of Namwater Desalination Plant

- CSIR – Kouga Wind Energy Project – Background Noise Measurements
- CSIR – Kouga Wind Energy Project
- CSIR – Wind Current Wind Energy Project
- CSIR – Langefontein Wind Energy Project
- CSIR – Mossel Bay Wind Energy Project
- CSIR – Coega IDZ Wind Energy Project
- CSIR – Baakenskop Wind Energy Project
- CSIR – Biotherm Wind Energy Project
- CSIR – Innowind Mossel Bay
- CSIR – Langefontein Wind Energy Project
- CSIR – Bulk Manganese Terminal (Port of Ngqura)
- CSIR – Phyto Amandla Biodiesel Project
- CSIR – Vleesbaai Wind Energy Project
- CSIR - Kudusberg Wind Energy Project
- CES – Coega IDZ Gas to Power Project (Current)
- CES – Coega IDZ Wind Energy Project
- CES – Middleton Wind Energy Project
- CES – Waainek Wind Energy Project
- CES – Ncora Wind Energy Project
- CES – Qunu Wind Energy Project
- CES – Nqamakwe Wind Energy Project
- CES – Plan 8 Wind Energy Project
- CES – Qumbu Wind Energy Project
- CES – Peddie Wind Energy Project
- CES – Cookhouse Wind Energy Project
- CES – Madagascar Heavy Minerals
- CES – Richards Bay Wind Energy Project
- CES – Hluhluwe Wind Energy Project
- CEN – Kwandwe Airport Development Project
- CEN – Swartkops Manganese Project
- CEN – N2 Petro Port Project
- SiVest - Rondekop Wind Energy Project
- SiVest - Tooverberg Wind Energy Project
- SRK – Roodeplaat Wind Energy Project
- SRK – Tronox Slimes Dam Pumping Station
- Savannah - Witberg Wind Energy Project
- Savannah - Kareebosch Wind Energy Project

TERTIARY EDUCATION

- PhD - University of Pretoria (Environmental Management)
- Various Health & Safety Courses.
- National Diploma Health & Safety Management
- Harvard University – Applications of Industrial Hygiene Principles – including noise
- United States EPA Pollution Measurement course conducted at the University Of Cincinnati (EPA Training Centre)
- US EPA Air Dispersion Modelling Training Course
- Master of Business Administration (University of Wales) with dissertation on environmental reporting in South Africa.
- Environmental Auditor (ISO 14001:2015 and ISO 45001:2018)

……………………..

Annexure B: Specialist Statement of Independence

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Environmental Impact Assessment (EIA) for the proposed development of the Klipkraal Wind Energy Facility (WEF) 1, BESS and associated infrastructure near Fraserburg in the Northern Cape Province

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	SAFETECH			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Non-Compliant	Percentage Procurement recognition	0
Specialist name:	Dr Brett Williams			
Specialist Qualifications:	PHD			
Professional affiliation/registration:	Registered Occupational Hygienist			
Physical address:	64 Worraker Street, Newton Park, Gqeberha			
Postal address:	PO BOX 27607, Greenacres			
Postal code:	6057	Cell:	082 550 2137	
Telephone:	041 365 6846	Fax:	041 365 2123	
E-mail:	Brett.williams@safetech.co.za			

2. DECLARATION BY THE SPECIALIST

I, Brett Williams, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Safetech

Name of Company:

28/07/2022

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

3. **UNDERTAKING UNDER OATH/ AFFIRMATION**

I, Brett Williams, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Safetech

Name of Company

28/07/2022

Date

Signature of the Commissioner of Oaths

19/08/2022

Date

CINDY KILLIAN
COMMISSIONER OF OATHS
PRACTISING ATTORNEY
70 WORRAKER STREET, NEWTON PARK
PORT ELIZABETH, 6045

Annexure C: Impact Assessment Methodology (SiVEST)

1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		

1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The table below is to be represented in the Impact Assessment section of the report. The excel spreadsheet template can be used to complete the Impact Assessment.

Annexure D: Compliance with the Noise Assessment Protocol (GN 320, 20 March 2020)

Compliance with Specialist Noise Impact Assessment as per GNR 320 of the EIA Regulations March 2020	
Requirement	**Section**
Baseline Description	
Current Residual sound levels over 2 nights	3.2
Records of approximate wind speed	3.2
Mapped Distance of the receiver from the proposed source	4.1 (Table 8)
Discussion of temporal aspects of ambient conditions	3.2
Assessment in accordance with SANS 10103:2008 & 10328:2008	
Characterization of noise (e.g. frequency, temporal, content, vibration)	2.1
Projected noise during construction, commissioning, and operation	5.0
Desired noise levels for the area	7.0
Noise Specialist Report Requirements	
CV of Specialist	Annexure A
Signed statement of independence	Annexure B
Duration and date of field study and weather conditions	Annexure G
Description of methodology (equipment used & results of noise study)	3.2
Map of proposed development with buffer	2.2 (Figure 4)
Confirmation that all reasonable mitigation measure has been considered	9.2
Substantiated statement of acceptability (or not) and recommendation of approval	9.1
Any conditions to which statement is objected	9.2
Identify alternative development footprints within the preferred site that would be "low"	N/A
Motivation if alternatives found	N/A
Mitigation measures input into EMPr	8.0
Assumptions and limitations	1.6

Annexure E: Decibel Reference Scale

	Degree		Pressure Level	Source
32 GW	Deafening		225 dB	12" Cannon @ 12ft in front and below
25 to 40 MW			195 dB	Saturn Rocket
100 Kw			170 dB	Turbojet engine with afterburner
10 Kw			160 dB	Turbojet engine, 7000lb thrust
1 kW			150 dB	4 Propeller Airliner
100 W			140 dB	Artillery Fire
10 W	Threshold of pain		130 dB	Pneumatic Rock Drill
				130 dB causes immediate ear damage
3 W			125 dB	Small aircraft engine
1.0 W			120 dB	Thunder
100 Mw			110 dB	Close to train
10 mW	Very Loud		100 dB	Home lawn mower
1 mW			90 dB	Symphony or a Band
				85 dB regularly can cause ear damage
100 uW	Loud		80 dB	Police whistle
10 uW			70 dB	Average radio
1 uW	Moderate		60 dB	Normal conversational voice
100 nW			50 dB	Quiet stream
10 nW	Faint		40 dB	Quiet conversation
1 nW			30 dB	Very soft whisper
100 pW	Very faint		20 dB	Ticking of a watch
10 pW	Threshold of hearing		10 dB	
1 pW			0 dB	Absolute silence

Annexure F: Site Sensitivity Report

Prior to commencing with the Noise Specialist Assessment in accordance with the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity (Government Notice 320, dated 20 March 2020), a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

Date of Site Visit	18/09/2021 – 24/09/2021
Specialist Name	Dr Brett Williams
Professional Registration Number	0220
Specialist Affiliation / Company	South African Institute of Occupational Hygienists (SAIOH)

SAFETECH
Since 1992

ENVIRONMENT
HEALTH
SAFETY

SITE SENSITIVITY VERIFICATION REPORT

FOR THE KLIPKRAAL WIND ENERGY FACILITY 1 NEAR FRASERBURG, NORTHERN CAPE.

Date of Site Visit:	18/09/2021 – 24/09/2021
Specialist Name:	Dr Brett Williams
Professional Registration Number:	SAIOH 0221
Specialist Affiliation / Company:	Safetech
Specialist Topic:	Noise Impact Assessment
Document Version:	Version 2
Proposed WEF Project Name:	Klipkraal Wind Energy Facility 1

28th July 2022

HWSETA
HW592A1000508

Northern Office: PO Box 80171, Doornpoort, Pretoria, 0017 Tel: +27 (0)82 411 1571 Fax: +27 (0)86 6579864

Southern Office: PO Box 27607, Greenacres, Port Elizabeth 6057 Tel: +27 (0)41 3656846 / Fax: +27 (0)41 3652123 info@safetech.co.za / www.safetech.co.za

Safetrain cc T/A Safetech Reg. No 1992/034818/23 VAT No. 4180135461 Directors: B Williams, C Williams

Approved Inspection Authority (OH0049-CI-09)

1. Introduction

Klipkraal Wind Facility 1 (Pty) Ltd proposes to develop the Klipkraal Wind Energy Facility 1 and Grid Connection located to the south of Fraserburg in the Northern Cape. The Wind Energy Facility (WEF) will be one of five, separate wind developments proposed by the developer. This report will only address the Klipkraal WEF 1. Safetech has been appointed to conduct the noise impact assessment.

The first stage in the assessment is to conduct a site sensitivity report as per the requirements of the Environmental Assessment Protocols of the NEMA EIA Regulations (2014, as amended), and the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Noise Impacts (GG 43110 / GNR 320, 20 March 2020).

The grid connection will not require a full noise impact assessment. The noise from the construction of the grid connection will be addressed in the final EIA report.

The potential noise impacts from the construction and operation of the proposed development of the Klipkraal Wind Energy Facilities and Grid Connection will including the following:

- Construction equipment and vehicle noise
- Mechanical and aerodynamic noise from the operation of the various wind turbine components.

The impacts of mechanical and aerodynamic noise are described in detail below.

2. Description of Noise Impacts

The sources of sounds emitted from operating wind turbines can be divided into two categories, firstly mechanical sounds, from the interaction of turbine components, and secondly aerodynamic sounds, produced by the flow of air over the blades and past the tower.

Mechanical Sounds

Mechanical sounds originate from the relative motion of mechanical components and the dynamic response among them. Sources of such sounds include:

- Gearboxes
- Main electrical generator
- Yaw Drives
- Cooling Fans and
- Auxiliary Equipment (e.g. hydraulic pumps).

Since the emitted sound is associated with the rotation of mechanical and electrical equipment, it tends to be tonal (of a common frequency), although it may also have a broadband component. For example, pure tones can be emitted at the rotational frequencies of shafts and generators, and the meshing frequencies of the gears.

In addition, the hub, rotor, and tower may act as loudspeakers, transmitting the mechanical sound and radiating it. The transmission path of the sound can be air-borne or structure-borne. Air-borne means that the sound is directly propagated from the component surface or interior into the air. Structure-borne sound is transmitted along other structural components before it is radiated into the air.

SAFETECH

Figure 1 below shows the type of transmission path, and the sound power levels for the individual components for a wind turbine.

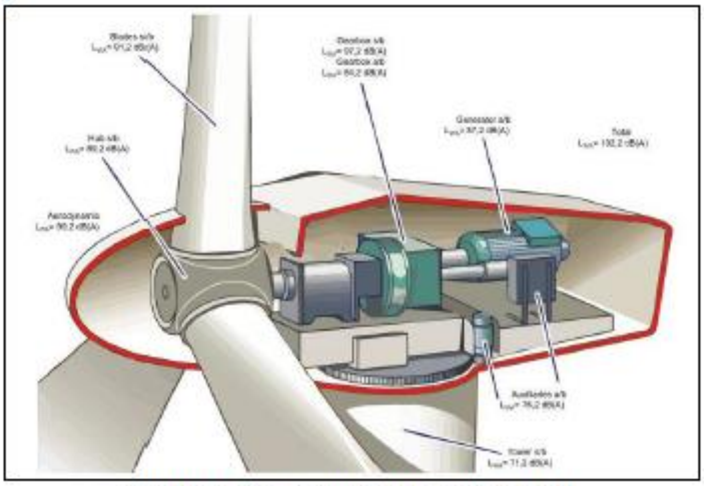


Figure 1: Typical Sound Power Levels of a Turbine (Moraleda 2019).

Aerodynamic Sound

Aerodynamic broadband sound is typically the largest component of wind turbine acoustic emissions. It originates from the flow of air around the blades, especially the downward moving blade. A large number of complex flow phenomena occur, each of which might generate some sound (see Figure 2). Aerodynamic sound generally increases with rotor speed. The various aerodynamic sound generation mechanisms that must be considered are divided into three groups:

- Low Frequency Sound: Sound in the low frequency part of the sound spectrum is generated when the rotating blade encounters localized flow deficiencies due to the flow around a tower, wind speed changes, or wakes shed from other blades.
- Inflow Turbulence Sound: Depends on the amount of atmospheric turbulence. The atmospheric turbulence results in local force or local pressure fluctuations around the blade.
- Airfoil Noise: This group includes the sound generated by the air flow right along the surface of the airfoil. This type of sound is typically of a broadband nature, but tonal components may occur due to blunt trailing edges, or flow over slits and holes.

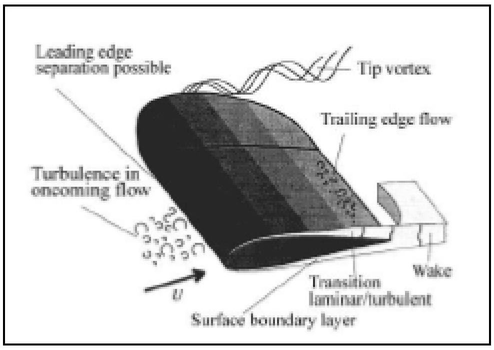


Figure 2: Sources of Aerodynamic Noise (Wagner 1996).

Modern airfoil design takes all the above factors into account and is generally much quieter that the first generation of bade designs.

Residual Sound & Wind Speed

The ability to hear a wind turbine depends on the residual sound level[1]. When the background sounds and wind turbine sounds are of the same magnitude, the wind turbine sound may get lost in the background noise. Both the wind turbine sound power level and the residual sound pressure level will be functions of wind speed. Thus, whether the sound emitted from a wind turbine exceeds the residual sound level will depend on how each of these varies with wind speed.

The most likely sources of wind-generated sounds are interactions between wind and vegetation. Several factors affect the sound generated by wind flowing over vegetation. For example, the total magnitude of wind-generated sound depends more on the size of the windward surface of the vegetation than the foliage density or volume.

The sound level and frequency content of wind generated sound also depends on the type of vegetation. For example, sounds from deciduous trees tend to be slightly lower and more broadband than that from conifers, which generate more sounds at specific frequencies. The equivalent A-weighted broadband sound pressure generated by wind in foliage has been shown to be approximately proportional to the base 10 logarithm of wind speed.

Sound emitted from large modern wind turbines during constant speed operation tend to increase more slowly with increasing wind speed, than wind generated sound. As a result, wind turbine noise is more commonly a concern at lower wind speeds, and it is often difficult to measure sound from modern wind turbines above wind speeds of 8 m/s because the background wind-generated sound sometimes masks the wind turbine sound above 8 m/s.

It should be remembered that average sound level measurements might not indicate when a sound is detectable by a listener. Just as a dog's barking can be heard through other sounds, sounds with particular frequencies or an identifiable pattern may be heard through background sounds that is otherwise loud enough to mask those sounds. Sound emissions from wind turbines will also vary as the turbulence in the wind through the rotor changes. Turbulence in ground level winds will also affect a listener's ability to hear other sounds. Because fluctuations in ground level wind speeds will not exactly correlate with those at the hub height of the turbine, a listener might find moments when the wind turbine could be heard over the residual sound.

[1] In laymans terms this is the "ambient sound or background noise" although this is defined difenrently in environmental noise legislation.

Low Frequency Noise and Infrasound

Infrasound was a significant characteristic of some wind turbine models that has been attributed to early designs in which turbine blades were downwind of the main tower. The effect was generated as the blades cut through the turbulence generated around the downwind side of the tower. Modern designs generally have the blades upwind of the tower. Wind conditions around the blades and improved blade design minimize the generation of the effect.

As depicted in Figure 3 below, low frequency pressure vibrations are typically categorized as low frequency sound when they can be heard near the bottom of human perception (10-200 Hz), and infrasound when they are below the common limit of human perception. Sound below 20 Hz is generally considered to be infrasound, even though there may be some human perception in that range. Because the ranges of low frequency sound and infrasound overlap it is important to understand how the terms are applied in a given context.

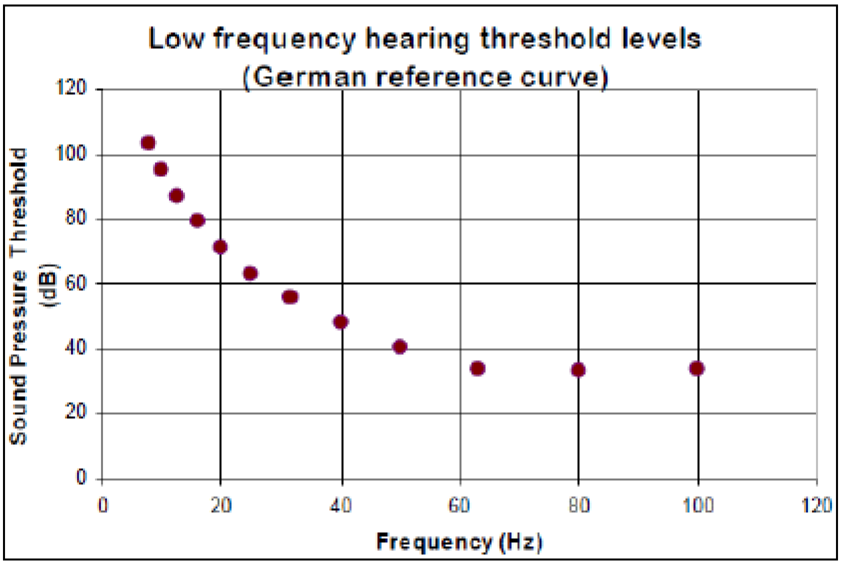


Figure 3: Low Frequency Hearing Threshold Levels

Infrasound is always present in the environment and stems from many sources including residual air turbulence from wind, ventilation units, waves on the seashore, distant explosions, traffic, aircraft, and other machinery. Infrasound propagates farther (i.e., with lower levels of dissipation) than higher frequencies. To place infrasound in perspective, when a child is swinging high on a swing, the pressure changes on their ears, from top to bottom of the swing, is nearly 120 dB(A) at a frequency of around 1 Hz.

Some characteristics of the human perception of infrasound and low frequency sound are:

- Low frequency sound and infrasound (2-100 Hz) are perceived as a mixture of auditory and tactile sensations
- Lower frequencies must be of a higher magnitude (dB) to be perceived, e.g., the threshold of hearing at 10 Hz is around 100 dB (see Figure 3 above)

- Tonality cannot be perceived below around 18 Hz and
- Infrasound may not appear to be coming from a specific location, because of its long wavelengths.

The primary human response to perceived infrasound is annoyance, with resulting secondary effects. Annoyance levels typically depend on other characteristics of the infrasound, including intensity, variations with time, such as impulses, loudest sound, periodicity, etc. Infrasound has three annoyance mechanisms:

- A feeling of static pressure
- Periodic masking effects in medium and higher frequencies; and
- Rattling of doors, windows, etc. from strong low frequency components.

Human effects vary by the intensity of the perceived infrasound, which can be grouped into these approximate ranges:

- 90 dB and below: No evidence of adverse effects'
- 115 dB: Fatigue, apathy, abdominal symptoms, hypertension in some humans
- 120 dB: Approximate threshold of pain at 10 Hz and
- 120 – 130 dB and above: Exposure for 24 hours causes physiological damage.

The typical range of sound power level for wind turbine generators is in the range of 100 to 105 dB(A) – a much lower sound power level (10 dB or more) than the majority of construction machinery such as bulldozers. For infrasound to be audible even to a person with the most sensitive hearing at a distance of 300 m would require a sound power level of at least 140 dB at 10 Hz and even higher emission levels than this at lower frequencies and at greater distances. There is no information available to indicate that wind turbine generators emit infrasound anywhere near this intensity.

3. Possible Mitigation Measures of Potential Noise Impacts

To mitigate the potential noise impacts of the proposed development, the following measures will be considered if needed:

- Construction Phase:
  - Conduct Noise Sensitivity Training for all construction staff where construction takes place close to sensitive receptors.
  - No construction should occur during night-time hours (22:00-06:00).
  - If possible, piling activities should occur during the hottest part of the day to take advantage of the unstable atmospheric conditions.
  - Residual Noise Monitoring should be conducted during the construction phase at sensitive NSAs.
- Operational Phase:
  - Wind Turbine Generators (WTGs) should not be placed within 500m of any occupied Noise Sensitive Area (NSA).
  - If the night-time noise rating limit for rural areas (35dB(A)) is exceeded, the WTGs could be operated in a lower power mode at certain wind speeds or be relocated further away from an NSA.

The potential noise mitigation measures will be determined during the final modelling and noise impact assessment phase.

4. Description of the Affected Environment

Figure 4 below shows the regional context, including the four other wind energy developments bordering the proposed development. A total of 23 Noise Sensitive Areas (NSAs) were identified. The site verification process determined that most NSAs are not permanently occupied. Furthermore, some NSAs are kraals for livestock and abandoned buildings.

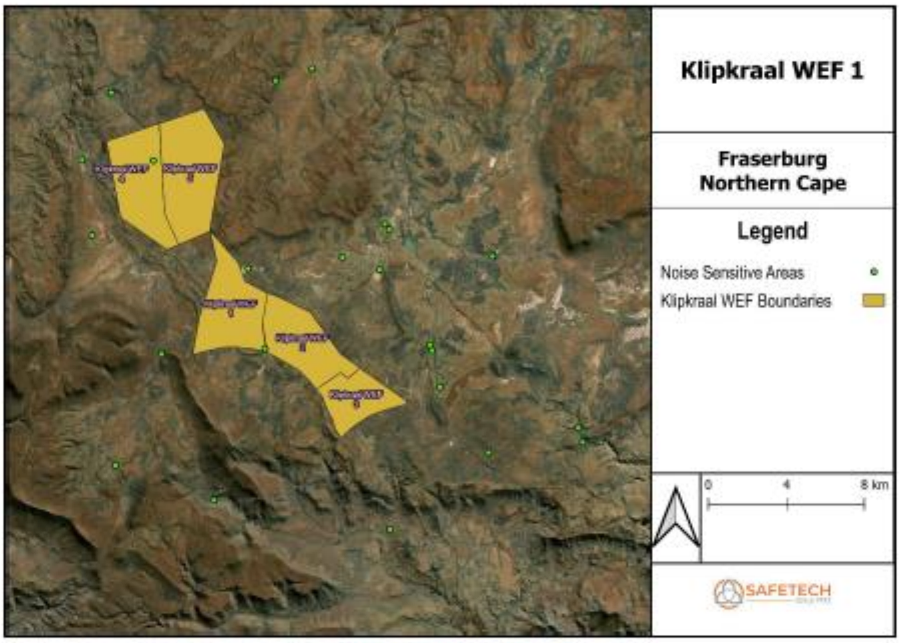


Figure 4: Klipkraal Regional Context

The noise emissions could have an impact on the residents at the NSA's. Figure 5 below shows the NSA's that are most likely to be impacted by Klipkraal WEF 1, due to their distance to the closest turbine. These distances are shown in Annexure B.

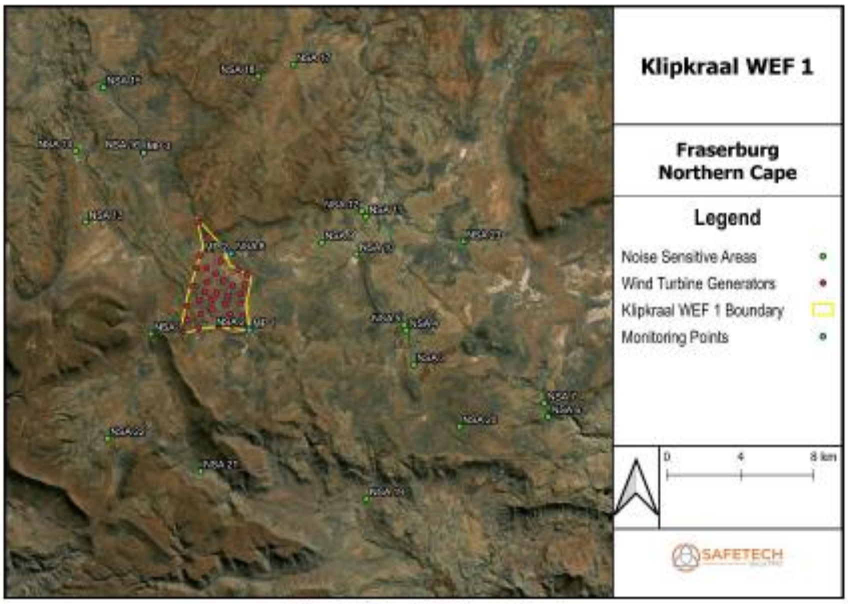


Figure 5: Klipkraal WEF 1 Local Context

Three noise measurements were conducted. The locations of the monitoring points (MP) are shown in Figure 5.

5. Field Study

The field study validated the classification of the study area as a rural district. Table 1 below shows the SANS 10103:2008 guidelines for day and night noise limits. National and provincial standards classify noise levels exceeding 7dB(A) above the ambient noise levels as a disturbing noise.

Table 1: Noise limits for rural districts

Type of District	Equivalent Continuous Rating Level, $L_{Req,T}$ for Noise					
	Outdoors (dB(A))			Indoors, with open windows (dB(A))		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
Rural Districts	45	45	35	35	35	25

The field study was conducted from the 18th of September 2021 to the 24th of September 2021 in accordance with SANS 10103:2008. The guidelines to determine the ambient noise levels of the area are described in the methodology below:

> *A long-term measurement was taken by placing a noise meter on a tripod and ensuring that it was placed at least 1.2 m from floor level and 3.5 m from any large flat reflecting surface. The 36-hour measurement time encompassed one "day" period (06:00-22:00) and two "night" periods (22:00-06:00). The noise meter was calibrated before and after the survey. At no time was the difference more than one decibel (dB) (Note: If the difference between measurements at the same point under the same conditions is more than 1 dB, then this is an indication that the noise meter is not properly calibrated). The weighting used was on the A scale and the meter was placed on "fast", which is the preferred*

method as per SANS 10103:2008, the measurement and rating of environmental noise. The meter was fitted with a windscreen, which is supplied by the manufacturer. The windscreen is designed to reduce wind noise around the microphone and not bias the measurements.

The results of the baseline residual noise monitoring for the three monitoring points are illustrated in Figures 6 to 11 below. The noise profiles during the time of the monitoring were typical of the rural landscape. Noise sources included birds chirping, occasional cars passing by wind and rustling of leaves from surrounding vegetation.

The details of the equipment used are as follows, the calibration certificates can be found in Annexure A:

- **Rion NL-62 and UC-59L Integrating Sound Level Meter with built-in ⅓-Octave Filter and ½" Microphone with NC-74 Sound Calibrator:** Type 1, Rion NL-62, NH-26, UC-59L Integrating Sound Level Meter with built-in ⅓-Octave Filter and ½" Microphone. Serial no.: 00420125; 01697; 00840. Calibrated by: M and N Acoustic Services cc on 06-20 July 2021 (calibration due July 2022 as per SANS 10083:2013). Certificate number: 2021-AS-0751. Calibration certificate attached in Annexure. Total uncertainty of measurements: Integrating Sound Level Meter: Refer to calibration certificate. ½" Microphone: ± 0.3 dB. Built-in ⅓-Octave Filter: ± 0.3 dB.

- **Rion NC-74, NC-74-002 Sound Calibrator:** Serial no.: 34425540. Calibrated by: M and N Acoustic Services cc on 07 July 2021 (calibration due July 2022). Certificate number: 2019-AS-0749. Calibration certificate attached in Annexure. Total uncertainty of measurements: Sound Calibrator: ± 0.19 dB

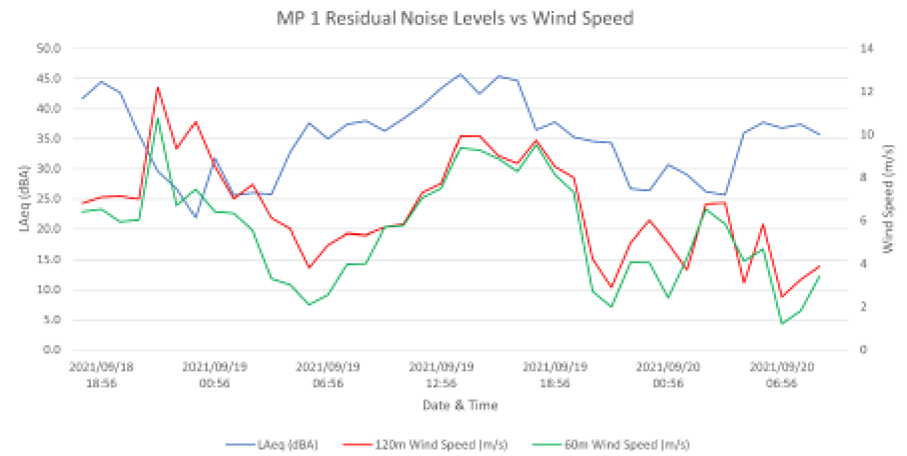


Figure 6: Monitoring Point 1 Residual Noise Levels vs Weather Conditions

Figure 7 below shows the frequency distribution of sound for MP 1 during the same time period.

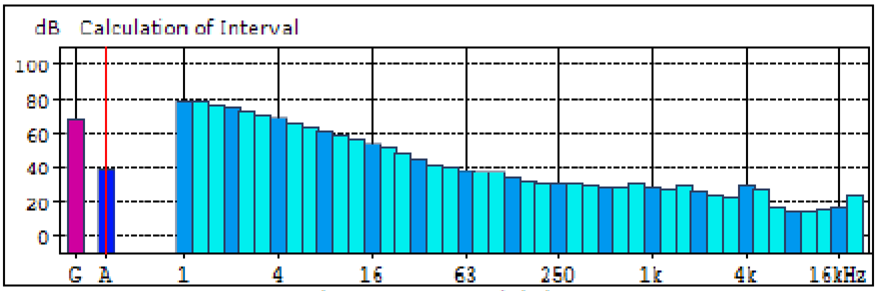


Figure 7: MP 1 Frequency Distribution

For MP 1 above, the L_{Aeq} value for the daytime period was 40.8 dB(A). The L_{Aeq} value for the night-time period was 30.3 dB(A).

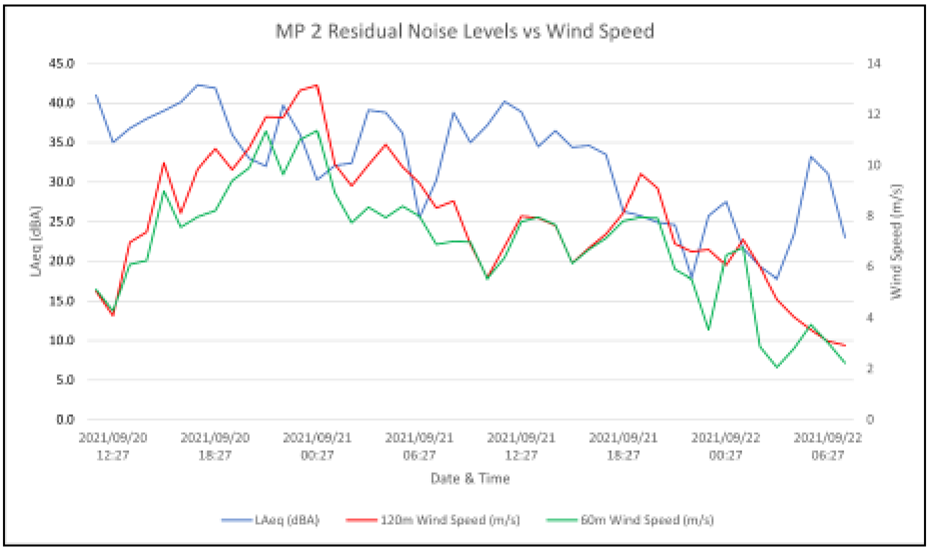


Figure 8: Monitoring Point 2 Residual Noise Levels vs Weather Conditions

Figure 9 below shows the frequency distribution of sound for MP 2 during the same time period.

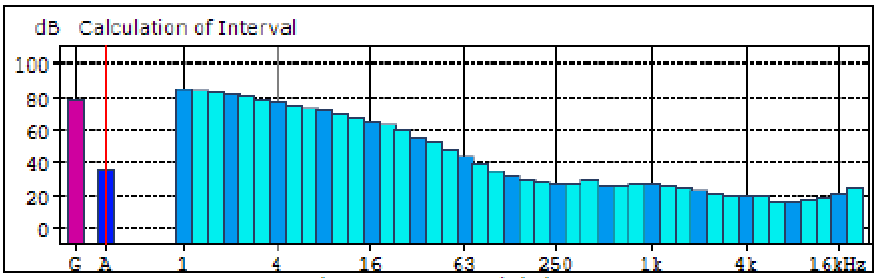


Figure 9: MP 2 Frequency Distribution

For MP 2 above, the L_{Aeq} value for the daytime period was 37.0 dB(A). The L_{Aeq} value for the night-time period was 34.0 dB(A).

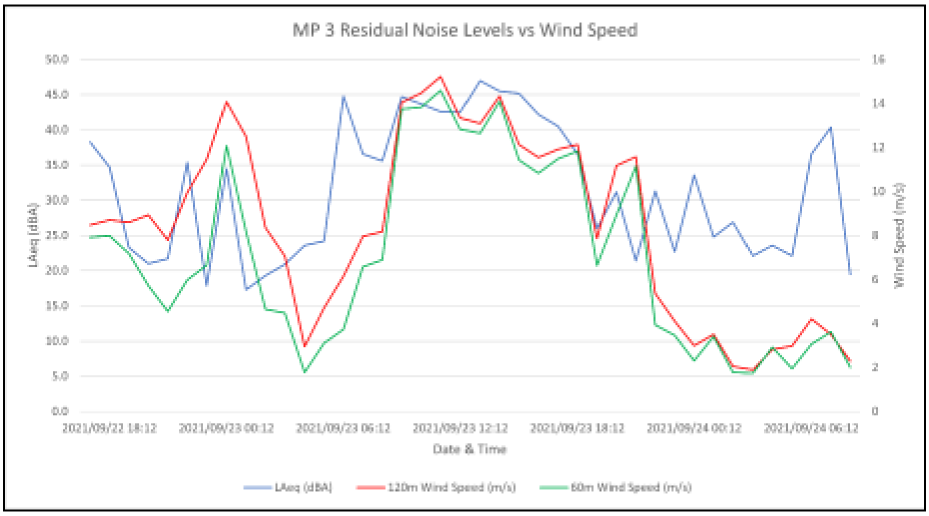


Figure 10: Monitoring Point 3 Ambient Noise Levels vs Weather Conditions

Figure 11 below shows the frequency distribution of sound for MP 3 during the same time period.

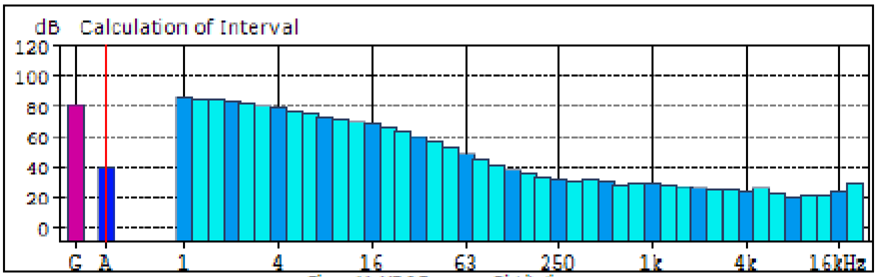


Figure 11: MP 3 Frequency Distribution

For MP 3 above, the L_{Aeq} value for the daytime period was 41.2 dB(A). The L_{Aeq} value for the night-time period was 28.8 dB(A).

The weather data for the monitoring period was supplied by the client. Two weather stations are located within the study area. Weather Station 2 wind speeds, recorded at 60m and 120m above ground level, were used as this station was closer to the monitoring points. The Coordinates of Weather Station 2 are: 32° 5' 29.40" S; 21° 47' 49.70" E.

6. Cumulative Study

As per the Screening Report, no other Wind Energy Facilities or Solar Farms are located within 30km of the proposed development. The cumulative impacts will not need to be assessed.

The cumulative impacts study will therefore only consider the other four Klipkraal Wind Energy Facilities, as shown in Figure 4.

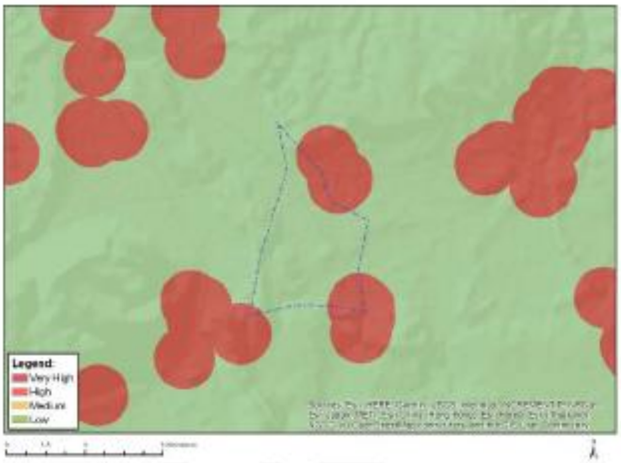
7. Grid Connection

From a noise perspective, no impacts are anticipated from the operation of the grid connection infrastructure. Therefore, a separate noise impact assessment will not be required. The noise impacts arising from the construction of the grid connection will be assessed as part of the construction of the Wind Energy Facilities (internal roads and turbines).

8. Screening Tool

Figure 12 below shows the noise themed sensitivities shown in the screening tool.

MAP OF RELATIVE NOISE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Area of low sensitivity
Very High	Potential temporarily or permanently inhabited residence

Figure 12: Noise Themed Sensitivities

The site visit confirmed the location of the Noise Sensitive Areas in Figure 12. Additional NSA's were also identified.

9. Legal Requirements

As part of the noise impact assessment, relevant noise related legislation and standards will be identified. Where applicable the following standards will also be consulted:

- South Africa - GNR.154 of January 1992: Noise control regulations in terms of section 25 of the Environment Conservation Act (ECA), 1989 (Act No. 73 of 1989).
- South Africa - GNR.155 of 10 January 1992: Application of noise control regulations made under section 25 of the Environment Conservation Act, 1989 (Act No. 73 of 1989).
- South Africa – GNR. 320 of 20 March 2020: Procedures for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes under Sections 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act no. 107 of 1998).
- SANS 10103:2008 Version 6 - The measurement and rating of environmental noise with respect to annoyance and to speech communication.
- SANS 10357:2004 Version 2.1 - The calculation of sound propagation by the Concawe method.
- International Finance Corporation – 2007 General EHS Guidelines: Environmental Noise.

10. Conclusion

The following is concluded and verified:

- The project site is situated in a rural district.
- The project could impact on several noise sensitive areas.
- It is recommended that a 500m buffer be placed around all noise sensitive receptors for planning purposes. The WTG layout for Klipkraal WEF 1 should adhere to this recommendation.

The proposed mitigations measures of the potential noise impacts have been described in Section 3.

It is recommended that a full noise impact assessment, that includes emission modelling be conducted. A comprehensive report will be provided that will include noise mitigation measures to be included in the environmental management plan as well as predicted noise levels during the construction and operation phase.

Dr Brett Williams

ANNEXURE A – Calibration Certificates

sanas Calibration Laboratory

M AND N ACOUSTIC SERVICES (Pty) Ltd

BEE Status: Level 4

No. 15, Mo...

Tel: 012 689-2007 ...

E-mail: admin@mnacoustics...

Website: www.mnacoustics.co.za

CERTIFICATE OF CALIBRATION

CERTIFICATE NUMBER	2021-AS-0751
ORGANISATION	RUBICEPT (PTY) LTD
ORGANISATION ADRESS	14 ROSE STREET, GQEBERHA
CALIBRATION OF	INTEGRATING SOUND LEVEL METER complete with built-in ⅓- OCTAVE/OCTAVE FILTER, ½" PRE-AMPLIFIER and ½" MICROPHONE
MANUFACTURERS	RION
MODEL NUMBERS	NL-62, NH-26 and UC-59L
SERIAL NUMBERS	00420125, 01697 and 00840
DATE OF CALIBRATION	06-20 JULY 2021
RECOMMENDED DUE DATE	JULY 2022
PAGE NUMBER	PAGE 1 OF 6

This certificate is issued in accordance with the conditions of approval granted by the South African National Accreditation System (SANAS). This Certificate may not be reproduced without the written approval of SANAS and M and N Acoustic Services.

The measurement results recorded in this certificate were correct at the time of calibration. The subsequent accuracy will depend on factors such as care, handling, frequency of use and the number of different users. It is recommended that re-calibration should be performed at an interval, which will ensure that the instrument remains within the desired limits and/or manufacturer's specifications.

The South African National Accreditation System (SANAS) is member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). This arrangement allows for mutual recognition of technical test and calibration data by member accreditation bodies worldwide. For more information on the arrangement please consult www.ilac.org

Authorised/Calibrated by:	Checked by:	Date of Issue:
M. NAUDE (SANAS TECHNICAL SIGNATORY)	N.E. BURGHAUT (CALIBRATION TECHNICIAN)	20 JULY 2021

Director: Marlanka Naudé

SAFETECH

sanas
Calibration laboratory
548
1202

M AND N ACOUSTIC SERVICES (Pty) Ltd
DEE Status: Level 4
P.O. Box 61713, Pierre van Ryneveld, 0045
No. 15, Mu... Avenue
Pierre van Ryn..., 0045
Tel: 012 689-2007 (076 ...) • Fax: ...
E-mail: admin@mnacoustics.co.za
Website: www.mnacoustics.co.za

CERTIFICATE OF CONFORMANCE

CERTIFICATE NUMBER	2021-AS-0749
ORGANISATION	RUBICEPT (PTY) LTD
ORGANISATION ADDRESS	14 ROSE STREET, GQEBERHA
CALIBRATION OF	SOUND LEVEL CALIBRATOR (complete with ½" Adapter)
MANUFACTURER	RION
MODEL NUMBER	NC-74 and NC-74-002
SERIAL NUMBER	34425540
DATE OF CALIBRATION	07 JULY 2021
RECOMMENDED DUE DATE	JULY 2022
PAGE NUMBER	PAGE 1 OF 3

This certificate is issued in accordance with the conditions of approval granted by the South African National Accreditation System (SANAS). This Certificate may not be reproduced without the written approval of SANAS and M and N Acoustic Services.

Calibrations performed by this laboratory are in terms of standards, the accuracies of which are traceable to national measuring standards as maintained by NMISA.

The measurement results recorded in this certificate were correct at the time of calibration. The subsequent accuracy will depend on factors such as care, handling, frequency of use and the amount of different users. It is recommended that re-calibration should be performed at an interval, which will ensure that the instrument remains within the desired limits and/or manufacturer's specifications.

The South African National Accreditation System (SANAS) is member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). This arrangement allows for mutual recognition of technical test and calibration data by member accreditation bodies worldwide. For more information on the arrangement please consult www.ilac.org

Authorized/Calibrated by:	Checked by:	Date of Issue:
M. NAUDE (SANAS TECHNICAL SIGNATORY)	N.J. BLIGNAUT (CALIBRATION TECHNICIAN)	09 JULY 2021

Director: Marianka Naudé

SAFETECH

ANNEXURE B – Closest Distance from Proposed WTGs to Noise Sensitive Areas

Name	Closest WTG Distance (m)
NSA 2	760
NSA 8	777
NSA 1	1 736
NSA 9	4 377
NSA 16	4 867
NSA 10	6 009
NSA 13	6 132
NSA 22	7 076
NSA 12	7 076
NSA 11	7 132
NSA 21	7 604
NSA 14	7 695
NSA 18	8 532
NSA 5	8 728
NSA 4	8 861
NSA 15	8 938
NSA 3	9 596
NSA 17	9 944
NSA 23	11 826
NSA 19	11 840
NSA 20	13 151
NSA 7	16 970
NSA 6	17 396